

***Arterial Real-Time Traveler Information  
(Commercial Probe Data)***

Minnesota Department of Transportation  
Innovative Ideas Program

Short Elliott Hendrickson Inc.  
INRIX

MnDOT No. 97544  
SEH No. MNTMD 116260

September 2012

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## Arterial Real-Time Traveler Information (Commercial Probe Data)

Prepared for Minnesota Department of Transportation

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### 1.0 Project Description

The project was designed to demonstrate an innovative, non-infrastructure based relatively low-cost approach to collect real-time traffic data on metro area arterials to be able to provide real time traffic information to motorists. Data provided could augment traffic data currently being collected by MnDOT and will provide a broader picture of traffic conditions in the metro area.

One of the project's primary goals was to confirm the accuracy and reliability of data collected. To do so data was collected for 5 months on Trunk Highway 100 to compare against existing traffic data collected from the in-place instrumentation by MnDOT's RTMC.

Real-time traffic data was also collected on three additional, non-instrumented arterial routes for a period of up to 6 months.

The project was designed to demonstrate the accuracy and reliability of traffic non-infrastructure based data collection on a major state arterial. Data was also collected on a major county arterial, since many of the major arterials in the metro area are county roads, and a rural interstate construction zone.

The original proposal was for providing real-time traffic data, but due to project constraints, historical travel times and one minute archived speed data were provided in the following format:

- Road segment
- Roadway name
- Time
- Average speed in MPH

Travel time along segment in minutes



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## 2.0 Project Minutes, Calendar, and Project Management Team



## MINUTES

### Arterial Real-Time Traveler Information - Commercial Probe Data

Wednesday, January 11, 2012

1:00 p.m.

MnDOT RTMC Conference Room 415

Meeting Chair: Tom Sohrweide

Minutes by: Tom Sohrweide

Present: Rashmi Brewer, Jon Jackels, Tim Johnson - MnDOT; Eric Drager, Greg Chock, Tom Johnson - Hennepin County; Dean Deeter, Tina Roelofs - Athey Creek; Roger Plum, Tom Sohrweide - SEH; Pete Costello - INRIX via phone

Copies to: Attendees and PMT

#### I. Data

##### A. INRIX

1. Archived once per minute to include:
  - a. Segment, Road Name, Time, Avg. Speed (mph), Segment Travel Time (min.)
2. Locations
  - a. TH 100 – I-694 to I-494 (15.8 miles), See attached
  - b. CSAH 81 – Greenhaven Drive to 36<sup>th</sup> Avenue (6.4 miles)
  - c. TH 55 – 7<sup>th</sup> Street N in Minneapolis to end of 4-lane (15.7 miles)
  - d. TH 7 – TH 100 to end of 4-lane (12.3 miles)
3. Confirm/Coordinate Roadway Segments

##### **Action Items:**

- 1. INRIX will provide data for RTMC segments.**
- 2. Athey Creek will provide Lats/Longs by segment for the other arterial routes.**

##### B. RTMC

1. Maintain TH 100 segments for the length of data collection?

##### **Action Items:**

- 1. It is not anticipated that RTMC will change segments during this project. This will be confirmed with Operations.**

##### C. Evaluation

1. SEH
  - a. TH 100
2. Athey Creek
  - a. All routes
3. Hennepin County
  - a. CSAH 81

##### **Action Items:**

- 1. Athey Creek will develop and evaluation matrix.**

- 2. Athey Creek will coordinate travel time runs for the arterial routes with their sub-consultant and Hennepin County.**
- 3. Travel time runs will be conducted during peak times.**
- 4. TH 100 evaluation will also look at off peak times.**
- 5. TH100 evaluation will use data base info from RTMC.**
- 6. Mini Blue Toad units and MBUF vehicle data may be used for supplemental data comparison.**

II. Schedule

- A. Functional Requirements – March 2
- B. INRIX to provide data – January 16 to June 1
- C. Evaluation – January 16 to June 1
- D. Final Report – July 31

**Action Items:**

- 1. Data will be provided from February 1 to June 1**

III. Miscellaneous

- A. Extend Contract to August 31
- B. Other

TH 100 Segments

Start

DMS Name = TT\_V100N01, T.H. 100 NB @77<sup>th</sup> Street, Lon = -93.34971 Lat = 44.86399

End 1 = station\_id="S389" label="Cedar Lake Rd" lon="-93.3426" lat="44.96683"

End 2 = station\_id="S1614" label="57th Ave" lon="-93.30902" lat="45.05858"

Start

DMS Name = TT\_V100N05, T.H. 100 NB @ Minnetonka Blvd, Lon = -93.34768 Lat = 44.95312

End 1 = station\_id="S393" label="T.H.55" lon="-93.34933" lat="44.98689"

End 2 = station\_id="S1614" label="57th Ave" lon="-93.30902" lat="45.05858"

Start

DMS Name = TT\_V100N08, T.H. 100 NB S of Duluth Street, Lon = -93.34938 Lat = 44.99244

End 1 = station\_id="S933" label="42nd Ave" lon="-93.3463" lat="45.03261"

End 2 = station\_id="S1614" label="57th Ave" lon="-93.30902" lat="45.05858"

Start

DMS Name = TT\_V100S04, T.H. 100 SB N of T.H. 55, Lon = -93.34945 Lat = 44.99091

End 1 = station\_id="S410" label="Minnetonka Blvd" lon="-93.34806" lat="44.947"

End 2 = station\_id="S421" label="77th St" lon="-93.35034" lat="44.86518"

Start

DMS Name = TT\_V100S07, T.H. 100 SB @ 50<sup>th</sup> Street, Lon = -93.35096 Lat = 44.9126

T.H. 100 SB N of 77<sup>th</sup> Street - NOT IN SERVICE  
No messages on the South 07 Sign

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

**If there are errors contained in this document, or if relevant information has been omitted, please contact Tom Sohrweide at 651.490.2072.**

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## MINUTES

### Arterial Real-Time Traveler Information - Commercial Probe Data

Thursday, May 10, 2012

9:00 a.m. CDT

MnDOT RTMC Room 315

Meeting Chair: Tom Sohrweide

Minutes by: Tom Sohrweide

Present: Rashmi Brewer, Dean Deeter, Tina Roelofs, Dennis Foderberg, Roger Plum, Tom Sohrweide

Copies to: Attendees, Pete Costello

#### I. Functional Requirements

##### A. Evaluation Requirements

1. 6.1 – Modify to indicate percentage for 1 min to 4 min.
2. 6.2 – Modify to include the detection of incident/event slow downs
3. 6.4 – Compare cost to similar method, i.e. Bluetooth, etc. Also compare cost of data for one segment and multiple segments.

##### B. Provide comments to SEH by May 18

#### II. Data Availability

##### A. Budget remains to provide data through May.

##### B. Athey Creek would like to have the May data by mid-June.

#### III. Evaluations

##### A. Athey Creek provided the attached preliminary data from their review.

##### B. SEH will provide the TH 100 data comparison without the 2 hour shift the presently exists on the spread sheet.

##### C. Athey Creek will look at the data for a rain event, May 3 during the A.M.

##### D. Athey Creek will review their findings directly with INRIX.

#### IV. Schedule

##### A. Athey Creek is planning to have a draft report by the end of June.

##### B. SEH is planning to have a draft report by the end of July.

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

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Arterial Real-Time Traveler Information - Commercial Probe Data

Thursday, May 10, 2012

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## MINUTES

Arterial Real-Time Traveler Information - Commercial Probe Data

Monday, May 16, 2011

8:00 a.m.

Mn/DOT RTMC Conference Room 415

Mn/DOT Contract No. 97544

SEH No. MNTMD 116260

Meeting Chair: Tom Sohrweide

Minutes by: Tom Sohrweide

Present: Mn/DOT - Rashmi Brewer, Jon Jackels; Athey Creek - Tina Roelofs; INRIX (via conference call) - Pete Costello; SEH - Dennis Foderberg, Tom Sohrweide

Copies to: Attendees

I. Introductions

II. I-35 Work Zone

**Action Items:**

- **Evaluation**

- **INRIX data should be evaluated for timeliness and accuracy**
- **Ver-Mac compiles INRIX data and displays delay results**
- **Driver understanding and use of display information**
- **Archived data**
  - **Tina will contact Pete to obtain data format**
  - **Rashmi will contact Ver-Mac to determine what they are archiving**

III. Project Scope

- A. Concept of Operations
- B. Site Development

**Action Items:**

- **I-394 would not be a good route for data comparison due to the MnPASS lanes. Select an alternative route, with consideration give to TH 100.**

C. Functional Requirements

**Action Items:**

- **Key requirements are latency and accuracy. Accuracy may reflect public satisfaction with current data that Mn/DOT provides.**

D. Data Analysis

IV. Evaluation

**Action Items:**

- **Mn/DOT and Athey Creek will develop an evaluation plan for routes other than the data comparison route. Included will be time periods to be evaluated.**
- **Mn/DOT to determine data archiving needs**

V. Schedule

**Action Items:**

- **Concept of Operations – July 15**
- **Site Development – August 15**
- **Functional Requirements – September 15**
- **Begin Data Collection – Mid September**

VI. Miscellaneous

**Action Items:**

- **Project Team will include those in attendance plus Scott County, Dakota County, Hennepin County, Mn/DOT Metro Traffic Operations, and FHWA.**
  - o **SEH – Contact the Counties**
  - o **Mn/DOT – Contact Metro and FHWA**
- **Mn/DOT and SEH schedule meeting for review of Con Ops by Project Team.**

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

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## MINUTES

### Arterial Real-Time Traveler Information - Commercial Probe Data

Wednesday, November 9, 2011

9:00 a.m.

MnDOT RTMC Conference Room 415

MnDOT Contract No. 97544

SEH No. MNTMD 116260

Meeting Chair: Tom Sohrweide

Minutes by: Tom Sohrweide

Present: Rashmi Brewer, Jon Jackels - MnDOT; Tony Winiecki - Scott County; Dean Deeter, Tina Roelofs - Athey Creek; Roger Plum, Tom Sohrweide - SEH

Copies to: Project Management Team

#### I. Concept of Operations

- A. Discussion on how INRIX data will be provided. INRIX had been asked to provide archived data (which includes average speed by segment and not travel time) for each route and indicated that individuals would have online access to real-time travel time data.
  - 1. Questions arose on how this method would fit with evaluation needs. It is desirable to have INRIX provide travel time data, so that any evaluation will be of their entire process without a 3<sup>rd</sup> party calculating travel times.
  - 2. There is a desire to have INRIX provide archived data with travel times.

#### Action Items

- 1. **SEH will contact INRIX with the following questions:**
  - a. **What level of effort and cost is required for INRIX to add travel time to the archived data?**
  - b. **If 1.a. isn't possible, how can travel time data be pulled from their system?**
  - c. **Could archived travel time data be provided for short periods, i.e. Monday AM peak 7:00 – 9:00, etc?**
  - d. **If 1.c. can be done, archived data with just average speeds can be used for comparison in less critical time periods.**
- 2. **SEH will report back the findings of the above and final direction will be determined and the Concept of Operations will be finalized.**

#### II. INRIX Data

- A. INRIX has provided October data and a listing of TMC data and it was unclear as to what the TMC data represented.

**Action Items**

- 3. It has been determined that the TMC data is by segment, but the segments in the table were not in sequential order.**
- 4. INRIX data has been put on hold until we can resolve exactly what will be provided.**

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

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## Project Management Team

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### 3.0 FHWA Quarterly Reports



**Quarterly Progress Report  
2011 – 2<sup>nd</sup>/3rd Quarter  
Submitted: October 14, 2011**

**Federal Work Order Number:** N/A

**State Contract Number:** 97544

**Project Name:** Arterial Real-Time Traveler Information – Commercial Probe Data

**Project Manager:** Rashmi Brewer, PE

**Project Objective:** To use commercially available floating car data from vehicle probes from a private sector data content provider (INRIX) to provide travel time and speed data on arterial roadways for six months and to validate the quality attributes of the data.

**Project Partners:**

- Minnesota Department of Transportation
- Short Elliott Hendrickson Inc.
- INRIX, Inc.
- Hennepin County
- Dakota County
- Scott County

**Work Completed:**

- Provided data for I-35 work zone
- Draft Concept of Operations

**Planned Activities:**

- Prepare the Functional Requirements
- Provide data for arterial routes
- Begin evaluation of that data

**Problems Encountered and Solutions/Actions Taken:**

- Sunday data for the I-35 work zone was found to be problematic. Use of that data was stopped.

**Products Available:**

- Draft Concept of Operations

**Outreach/Marketing Activities:**

- Maintained contact with the counties involved in the project

**Additional Comments:** None

**Budget Information:** [This information should be taken directly from the Federal Work Order]

	<b>Original Budget Amount</b>	<b>Amendment 1</b>	<b>Amendment 2</b>
<b>Federal</b>	-		
<b>State</b>	\$137,166		
<b>Other Funding</b>	-		
<b>Private Contributions</b>	-		
<b>Total</b>	\$137,166		

**Note: Counties are contributing in-kind services = \$16,800  
INRIX is contributing in-kind services = \$8,108**

**Mn/DOT Contract Number: 97544**

**Project Start Date: 4/20/11**

**Project End Date: 5/31/12**

**Expenditures for 2nd Quarter: \$35,099.74**

**Expenditures for 3rd Quarter: \$20,241.52**

**Budget Balance: \$81,824.74**

**Estimated Cost Variance at Completion: none**

**Additional Comments on Budget: none**

**Quarterly Progress Report  
2011 – 4th Quarter  
Submitted: January 10, 2012**

**Federal Work Order Number:** N/A

**State Contract Number:** 97544

**Project Name:** Arterial Real-Time Traveler Information – Commercial Probe Data

**Project Manager:** Rashmi Brewer, PE

**Project Objective:** To use commercially available floating car data from vehicle probes from a private sector data content provider (INRIX) to provide travel time and speed data on arterial roadways for six months and to validate the quality attributes of the data.

**Project Partners:**

- Minnesota Department of Transportation
- Short Elliott Hendrickson Inc.
- INRIX, Inc.
- Hennepin County
- Dakota County
- Scott County

**Work Completed:**

- Confirmed segments ends for TH 100
- Concept of Operations

**Planned Activities:**

- Prepare the Functional Requirements
- Provide data for arterial routes
- Begin evaluation of that data

**Problems Encountered and Solutions/Actions Taken:**

- None

**Products Available:**

- Draft Concept of Operations

**Outreach/Marketing Activities:**

- Maintained contact with the counties involved in the project

**Additional Comments:** None

**Budget Information:** [This information should be taken directly from the Federal Work Order]

	<b>Original Budget Amount</b>	<b>Amendment 1</b>	<b>Amendment 2</b>
<b>Federal</b>	-		
<b>State</b>	\$137,166		
<b>Other Funding</b>	-		
<b>Private Contributions</b>	-		
<b>Total</b>	\$137,166		

**Note: Counties are contributing in-kind services = \$16,800  
INRIX is contributing in-kind services = \$8,108**

**Mn/DOT Contract Number: 97544  
Project Start Date: 4/20/11  
Project End Date: 5/31/12**

**Expenditures for 4th Quarter: \$19,988.08**

**Budget Balance: \$61,836.65**

**Estimated Cost Variance at Completion: none**

**Additional Comments on Budget: none**

**Quarterly Progress Report  
2012 – 1st Quarter  
Submitted: April 16, 2012**

**Federal Work Order Number:** N/A

**State Contract Number:** 97544

**Project Name:** Arterial Real-Time Traveler Information – Commercial Probe Data

**Project Manager:** Rashmi Brewer, PE

**Project Objective:** To use commercially available floating car data from vehicle probes from a private sector data content provider (INRIX) to provide travel time and speed data on arterial roadways for six months and to validate the quality attributes of the data.

**Project Partners:**

- Minnesota Department of Transportation
- Short Elliott Hendrickson Inc.
- INRIX, Inc.
- Hennepin County
- Dakota County
- Scott County

**Work Completed:**

- Draft Functional Requirements
- Began providing data for TH 100 and arterial routes

**Planned Activities:**

- Finalize Functional Requirements
- Provide data for arterial routes
- Evaluation of that data

**Problems Encountered and Solutions/Actions Taken:**

- None

**Products Available:**

- Concept of Operations
- Draft Functional Requirements

**Outreach/Marketing Activities:**

- Maintained contact with the counties involved in the project

**Additional Comments:** None

**Budget Information:** [This information should be taken directly from the Federal Work Order]

	<b>Original Budget Amount</b>	<b>Amendment 1</b>	<b>Amendment 2</b>
<b>Federal</b>	-		
<b>State</b>	\$137,166		
<b>Other Funding</b>	-		
<b>Private Contributions</b>	-		
<b>Total</b>	\$137,166		

**Note: Counties are contributing in-kind services = \$16,800  
INRIX is contributing in-kind services = \$8,108**

**Mn/DOT Contract Number: 97544**

**Project Start Date: 4/20/11**

**Project End Date: Amended from 5/31/12 to 10/31/12**

**Expenditures for 1<sup>st</sup> Quarter: \$15,106.83**

**Budget Balance: \$46,729.82**

**Estimated Cost Variance at Completion: none**

**Additional Comments on Budget: none**

**Quarterly Progress Report  
2012 – 2nd Quarter  
Submitted: July 10, 2012**

**Federal Work Order Number:** N/A

**State Contract Number:** 97544

**Project Name:** Arterial Real-Time Traveler Information – Commercial Probe Data

**Project Manager:** Rashmi Brewer, PE

**Project Objective:** To use commercially available floating car data from vehicle probes from a private sector data content provider (INRIX) to provide travel time and speed data on arterial roadways for six months and to validate the quality attributes of the data.

**Project Partners:**

- Minnesota Department of Transportation
- Short Elliott Hendrickson Inc.
- INRIX, Inc.
- Hennepin County
- Dakota County
- Scott County

**Work Completed:**

- Functional Requirements
- Completed providing data for TH 100 and arterial routes

**Planned Activities:**

- Final Report

**Problems Encountered and Solutions/Actions Taken:**

- None

**Products Available:**

- Concept of Operations
- Functional Requirements

**Outreach/Marketing Activities:**

- Maintained contact with the counties involved in the project

**Additional Comments:** None

**Budget Information:** [This information should be taken directly from the Federal Work Order]

	<b>Original Budget Amount</b>	<b>Amendment 1</b>	<b>Amendment 2</b>
<b>Federal</b>	-		
<b>State</b>	\$137,166		
<b>Other Funding</b>	-		
<b>Private Contributions</b>	-		
<b>Total</b>	\$137,166		

**Note: Counties are contributing in-kind services = \$16,800  
INRIX is contributing in-kind services = \$8,108**

**Mn/DOT Contract Number: 97544**

**Project Start Date: 4/20/11**

**Project End Date: Amended from 5/31/12 to 10/31/12**

**Expenditures for 1<sup>st</sup> Quarter: \$27,658.58**

**Budget Balance: \$19,070.24**

**Estimated Cost Variance at Completion: none**

**Additional Comments on Budget: none**

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## 4.0 Concept of Operations



# **Concept of Operations**

## ***Arterial Real-Time Traveler Information (Commercial Probe Data)***

Minnesota Department of Transportation  
Innovative Idea Program

Short Elliott Hendrickson Inc.  
INRIX, Inc.

MnDOT Contract No. 97544  
SEH No. MNTMD 116260

December 2011



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# Concept of Operations

## Arterial Real-Time Traveler Information (Commercial Probe Data)

Prepared for Minnesota Department of Transportation, Innovative Idea Program

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### 1.0 Project Description

The project is intended to demonstrate an innovative, non-infrastructure based relatively low-cost approach to collect real time traffic data on metro area arterials to be able to provide real time traffic information to motorists. Data provided will augment traffic data currently being collected by MnDOT and will provide a broader picture of traffic conditions in the metro area.

The project is also intended to be able to confirm the accuracy and reliability of data collected. To do so data will be collected on a MnDOT roadway which is instrumented for a period of up to 6 months to compare against existing traffic data collected by MnDOT's RTMC.

Data will also be collected on three additional, non instrumented arterial routes for a period of up to 6 months.

It is intended to demonstrate the accuracy and reliability of traffic non-infrastructure based data collection on a major state arterial. It will also include a major county arterial, since many of the major arterials in the metro area are county roads, and a rural interstate construction zone.

For each roadway, SEH Team member INRIX will provide the following archived data by roadway segment, as often as once per minute:

- Road segment
- Roadway name
- Time
- Average speed in MPH
- Travel time along segment in minutes

### 2.0 Problem Statement

*The problem is that traveler information on arterials, such as determining travel times, is limited in Minnesota and across the U.S.A.*

A significant investment has been made for ITS on arterials for traffic management purposes across the U.S.A. The infrastructure installed has, to date, not shown a demonstrated use for traveler information purposes such as creating travel times along an arterial corridor. Today, travel time information on arterials has been made available using *floating car data from vehicle probes* through INRIX.

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In 2007, the Research and Innovative Technology Administration (RITA) at U.S. DOT surveyed 107 Metropolitan Areas across the U.S.A. and found that only 17 of these metropolitan areas Distribute Arterial Travel Times to the Public<sup>1</sup>. Most of the roadway network that the traveling public relies upon is “dark” in that information about conditions like travel times and speeds represented as red, yellow or green on a map are not available for arterials. The U.S. DOT sponsored a series of twelve focus groups in 1997 in New York City; Washington, D.C.; Boston; Philadelphia; Los Angeles; and Orange County, California (two in each location). The focus group survey respondents wanted advanced traveler information service (ATIS) coverage of all major freeways and arterials in their region<sup>2</sup>. We believe that today, travelers in the Twin Cities also expect this type of all encompassing coverage.

Arterials serve as alternatives to limited access roadways when they are congested and vice versa, but the traveling public does not know enough about their travel choices to make informed decisions. By providing travel time information on arterials, travelers can make better decisions when commuting or during special events.

The benefits of offering travel times and arterial information to travelers include:

Vehicle emission reduction

- Simulation results indicated that vehicle emissions could be reduced by two percent if arterial traffic flow data were included in the traveler information system in Seattle, Washington<sup>3</sup>.

Vehicle throughput increased and reduced travel times

- A simulation study indicated that vehicle throughput would increase if arterial data were integrated with freeway data in an Advanced Traveler Information System in Seattle, Washington<sup>4</sup>.

Vehicle delay, stops reduction, and traffic smoothing

- A simulation study of the road network in Seattle, Washington demonstrated that providing information on arterials as well as freeways in a traveler information system reduced vehicle-hours of delay by 3.4 percent and reduced the total number of stops by 5.5 percent<sup>5</sup>.

<sup>1</sup><http://www.itsdeployment.its.dot.gov/Results.asp?year=2007&rpt=M&filter=1&ID=336>

<sup>2</sup>ATIS: What do ATIS Customers Want?  
[http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS\\_TE/12284.pdf](http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/12284.pdf)

<sup>3</sup> Metropolitan Model Deployment Initiative: Seattle Evaluation Report - Final Draft: Author: Jensen, M., et al. (SAIC, Battelle, Mitretek, and Volpe)  
<http://www.itsbenefits.its.dot.gov/its/benecost.nsf/ID/0709762313E1CC3C8525733A006D4DFC?OpenDocument&Query=BApp>

<sup>4</sup> ITS Impacts Assessment for Seattle MMDI Evaluation: Modeling Methodology and Results  
Author: Wunderlich, Karl, James Bunch and James Larkin  
<http://www.itsbenefits.its.dot.gov/its/benecost.nsf/ID/1141BDF33A54739C85256A6C0053145B?OpenDocument&Query=BApp>

<sup>5</sup> Impacts of Supplementing Web-Based Urban Freeway ATIS With Parallel Arterial Travel-Time Data. Author: Wunderlich, Karl and James Larkin

### 3.0 Stakeholder Description

Over the course of the project a number of stakeholders will be involved in the project. Involvement will vary depending on the stakeholder roles and responsibilities. Stakeholders that have direct involvement in delivering the project have joined together to form the Project Management Team (PMT). Following is a list of the PMT members

MnDOT Project Manager Rashmi Brewer <a href="mailto:Rashmi.Brewer@state.mn.us">Rashmi.Brewer@state.mn.us</a> 651.234.7063	Hennepin County Eric Drager <a href="mailto:Eric.drager@co.hennepin.mn.us">Eric.drager@co.hennepin.mn.us</a> 612.596.0309
MnDOT Jon Jackels <a href="mailto:Jon.Jackels@state.mn.us">Jon.Jackels@state.mn.us</a> 651.234.7377	Hennepin County Greg Chock <a href="mailto:Greg.chock@co.hennepin.mn.us">Greg.chock@co.hennepin.mn.us</a> 612.596.0758
SEH Project Manager Tom Sohrweide <a href="mailto:tsohrweide@sehinc.com">tsohrweide@sehinc.com</a> 651.490.2072	Scott County Tony Winiecki <a href="mailto:twiniecki@co.scott.mn.us">twiniecki@co.scott.mn.us</a> 952.496.8008
FHWA Jim McCarthy <a href="mailto:James.mccarthy@dot.gov">James.mccarthy@dot.gov</a> 651.291.6112	SEH Dennis Foderberg <a href="mailto:dfoderberg@sehinc.com">dfoderberg@sehinc.com</a> 651.491.0878
Dakota County Kristi Sebastian <a href="mailto:Kristi.sebastian@co.dakota.mn.us">Kristi.sebastian@co.dakota.mn.us</a> 952.891.7178	INRIX, Inc. Pete Costello <a href="mailto:pete@inrix.com">pete@inrix.com</a> 202.550.5795
MnDOT Terry Haukom <a href="mailto:Terry.Haukom@state.mn.us">Terry.Haukom@state.mn.us</a> 651.234.7980	Athey Creek Tina Roelofs <a href="mailto:roelofs@acconsultants.org">roelofs@acconsultants.org</a> 651.207.5638
	Athey Creek Dean Deeter <a href="mailto:deeter@acconsultants.org">deeter@acconsultants.org</a> 651.207.5638

There are also a number of stakeholders that may have an interest or become exposed to the project. Those stakeholders include:

- Drivers: This group of stakeholders consists of the driving public who will be exposed to the travel time information in relation to the construction zone and ultimately for the arterial routes. Obviously, this is the group that the project is intended to impact.

- 
- **Operations Staff:** The operations staff of the RTMC will ultimately be the user of the data provided for conveyance to the driving public. Their interest will be to assure that the data provided via this means is able to integrate into MnDOT's existing system for travel time display.
  - **Other Interested Parties:** Interest is anticipated from other governmental agencies that maintain high volume arterial roadways.

#### **4.0 Project Objectives**

The objective of this project is to not create any new technology to support the concept test; rather, to utilize and extend proven commercial service from a GPS-base probe vehicle reporting network (over 30 million vehicles), allowing data to be provided with minimal risk to MnDOT and to offer a cost-effective non-infrastructure based technology compared to traditional ITS infrastructure.

INRIX's Traffic Fusion Engine will report traffic flow by road segment using the emerging private market standard of Traffic Message Channel (TMC) location codes. TMC road segments are based directly on the region's transportation network, with freeway segments defined at and between interchanges and arterial segments defined between major cross streets. MnDOT will provide the coordinate data for the major state arterial segments. INRIX will use these coordinates for data reporting by segment.

#### **5.0 Concept of Operation - General Operational Description**

Traffic data collection has traditionally been performed by public agencies charged with managing traffic flow, responding to incidents, carrying out planning activities, and maintaining roadways. Traditional sensor deployments include inductive loop detectors, closed-circuit television (CCTV) cameras, and other surveillance devices used to monitor conditions on roads within agency jurisdictions.

Recent advances in wireless communications and sensor technologies have resulted in increased private sector interest in the development of innovative traffic data collection solutions. Based on these innovations, cost-effective opportunities have begun to appear for public sector agencies to supplement and, in some cases, replace traditional traffic data collection infrastructure. More importantly, the existence of these technologies may, over time, result in a shift in the role played by the private sector from that of simple equipment vendor to provider of data products and services.

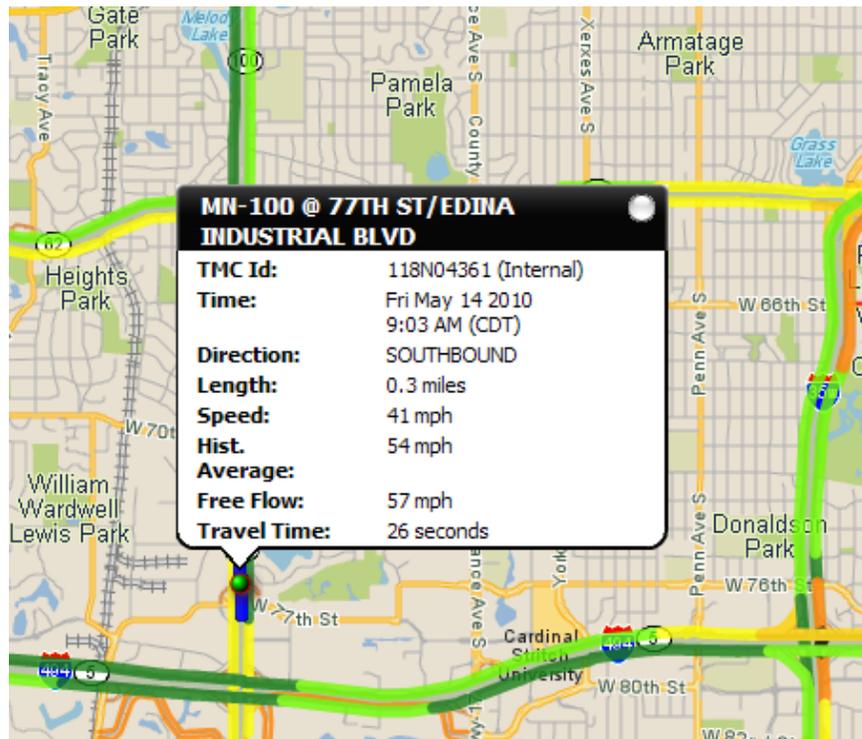
The intent of this project is to demonstrate an innovative, non-infrastructure based relatively low-cost approach to collect real time traffic data on metro area arterials to be able to provide real time traffic information to motorists. Data provided will augment traffic data currently being collected by MnDOT and will provide a broader picture of traffic conditions in the metro area.

It is also the intent of this project is to be able to confirm the accuracy and reliability of the INRIX data collected. Data will be collected on TH 100 for a period of up to 6 months to compare against existing traffic data collected by MnDOT's Regional Traffic Management Center (RTMC).

Data will also be collected on other routes as approved by the PMT. Evaluation of the data on these routes will be conducted by an independent evaluator.

For each roadway, SEH Team member INRIX will provide the following archived data by roadway segment, as often as once per minute:

- Road segment
- Roadway name
- Time
- Average speed in MPH
- Travel time along segment in minutes



## 5.1 A New Approach or Solution to an Existing Problem

The Arterial Real Time Traffic Information (Commercial Probe Data) using floating car data from probe vehicles is a different approach for Minnesota but has been demonstrated both nationally and internationally. Minnesota has past experience using vehicle probe data based on data taken from cell phones but to our knowledge none of these efforts addressed the need for reliable data on arterials. In addition, to our knowledge, none of these efforts resulted in an actual deployment.

The problem is that the Twin Cities, like most metropolitan areas across the U.S.A., have limited information available to travelers regarding congestion on its arterials. The 511 Deployment Coalition’s Guidelines state that arterial information is, along with highway information, one of the three basic content general categories of traveler information available via 511 services<sup>7</sup>.

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As the TRB paper *Prototype for Data Fusion Using Stationary and Mobile Data Sources for Improved Arterial Performance Measurement*<sup>8</sup> states “there is a potential to exploit the availability of mobile probe geolocation data from sources such as automatic vehicle location systems for fleets of transit buses or taxis, or from cellular phone or other GPS-type devices.” INRIX has been gathering this type of data with its Smart Driver Network for years in real-time on over 800,000 miles of roadway across the U.S.A. Real-time and historical data (over two years plus) is available throughout the Twin Cities to create travel times on arterials between a multitude of points established by MnDOT and its partners.

MnDOT and its partners can use existing resources like DMS (fixed and portable [if changeable in real-time via modem]), 511, websites, etc. to disseminate the arterial travel time information.

The addition of arterial travel time information available to the traveling public will also enhance MnDOT’s RTMC operations efforts. This information may also be used for: corridor management; planning and modeling purposes; reliability and performance measures; making operational decisions; etc. The arterial travel time information can also be queried on an archived basis for data analytics purposes.

## **5.2 A Modification to an Existing Approach**

The SEH Team will use INRIX’s data along arterials as part of its third generation routing engine which combines real-time, predictive and historical traffic information to provide navigation consumers with accurate fastest-route calculations and recommendations<sup>9</sup>. This existing approach in the marketplace has been modified for use by public sector agencies – designate an origin and destination and via a web services application programming interface (API) request and obtain the current travel time for that O/D pair via INRIX Connected Services.

INRIX’s new SpeedWaves<sup>TM</sup> technology calculates profiles of speed distributions per road segment that factor in the impact stop signs and other traffic control devices have on the billions of data points INRIX receives from over 30 million GPS-enabled vehicles and devices in its Smart Driver Network. This allows the use of specific, real-time information from these vehicles to accurately report traffic information throughout the road network, resulting in a true picture of actual traffic conditions on arterial and secondary roadways. The result is not merely an average of information from separate vehicles traveling on the same roadway, but an analysis of data from individual vehicle reports that accurately determines real-time congestion across the road segment.

The SEH Team will also make available an INRIX traffic application (apps) for the iPhone and Android Phone (possibly other mobile devices as well) for MnDOT, its partners and the public to see real-time traffic conditions in the area around the mobile device for the specific routes selected in this project. Details on apps are available at [www.INRIXTraffic.com](http://www.INRIXTraffic.com).

## **5.3 Global Positioning System-Based Probes**

GPS is a worldwide radio navigation system formed from a constellation of satellites and ground stations. While only a few years ago accuracy was about 100 meters, today’s GPS can pinpoint a location within 20 meters or less. The base data provided by GPS in vehicles is location and time. Point velocity, stop durations, space mean speed and travel time can be

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calculated using this data. GPSs are categorized as either active or passive. In passive systems, the GPS information is stored onboard and subsequently downloaded into a database whenever the vehicle is in proximity of a data download device or the onboard storage device's capacity has been met. In active systems, data transfer occurs in real-time via an integrated communications system.

Although recent tests indicate that position accuracy within 50 meters can be consistently achieved, and that data produced by such systems can consequently be used to generate speed and travel-time information for selected routes, the cost of deploying a sufficient number of active GPS to generate accurate probe data presents a major obstacle for public agencies interested in implementing this technology. Public agencies are more likely to use passive GPS to develop large archives of traffic conditions data for use in informing decision-makers.

However, the potential exists for data resources to become available from the private sector that could be utilized by public sector agencies to derive GPS-based speeds and travel times without the need to deploy stand-alone systems of their own.

If MnDOT wishes to make the project data available to the public via an existing website, INRIX will provide to the project a Traffic Tile Overlay for use on any Mercator projection base map (Google, Bing, etc.).

#### **5.4 Sustainability and Maintainability**

There is no infrastructure for MnDOT to operate or maintain and INRIX offers flexibility on the quantity of requests for travel time data for each route – as often as once a minute; only during rush hours; for special events; etc.

The data can be retrieved by MnDOT and output through the existing system which provides travel time information on freeways.

<sup>7</sup> (<http://www.deploy511.org/docs/implementationguidelines30.html>)

<sup>8</sup> (09-2280 [http://www.trb.org/am/ip/paper\\_detail.asp?paperid=27094](http://www.trb.org/am/ip/paper_detail.asp?paperid=27094))

<sup>9</sup> (<http://www.INRIX.com/pressrelease.asp?ID=53>)

#### **6.0 Concept of Operation - Operational Description**

This concept of operations system operational description is provided to identify the roles and responsibilities of the parties participating in this operational test. The information in this section may be used to drive the development of the site locations, functional requirements, and data analysis. However, the primary objective of this section is to provide guidance and clarity to the specific tasks that each stakeholder will need to take throughout the course of the project in order for the project to be successful.

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## 6.1 Site Locations

The following routes are included in the project.

- TH 100 – I-694 to I-494 (15.8 miles)
- CSAH 81 – Greenhaven Drive to 36<sup>th</sup> Avenue (6.4 miles)
- TH 55 – 7<sup>th</sup> Street N in Minneapolis to end of 4-lane (15.7 miles)
- TH 7 – TH 100 to end of 4-lane (12.3 miles)
- I-35 – Pine City to Carlton (66 miles)

MnDOT has existing real-time data for the TH 100 route. This route will be used to confirm that the traffic data provided by the SEH Team is determined to be accurate and reliable.

The original project cost estimate was based on a number of miles of roadway and can be adjusted to any route if modified by the PMT. A per mile cost estimate was also included in the cost proposal should the PMT decide to reduce or increase the number of arterial roadway miles actually included in the project.

The route selection process included:

- Route Characteristics
  - No exclusive lane designations
  - Data available for comparison from existing sources
  - Arterial roadway
  - Peak hour travel time concerns
  - Other
- Route Development Issues
  - Commercial vehicle traffic
  - Urban setting
  - Other

## 6.2 Functional Requirements

A draft and then final Functional Requirements document that describe the project data characteristics and parameters will be developed. The Functional Requirements document will also include a description and process for the analysis of the project data sets. The document will be developed, reviewed and finalized through the following subtasks:

- Develop draft Functional Requirements document explaining the operational parameters, data collection strategy, and route specific characteristics that impact or influence the project data collection and analysis.
- The Functional Requirements document will cover both technical as well as policy issues and will address such issues as reliability, serviceability, and ease of use; as well as effectiveness in collecting real-time data and providing real-time traveler information.
- Facilitate review of the Functional Requirements document by the PMT. The PMT must approve of the functional requirements prior to the start of the data collection, archive, and analysis process.
- Incorporate input received from the PMT into a final Functional Requirements document.

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### **6.3 Project Data**

MnDOT will be provided with project data every two weeks for the first month of the project and then monthly for subsequent months.

The Traffic Data Service focuses on generating the data to support the project, including mobilization and project interface documentation. Upon completion of the project, a DVD archive will be provided to MnDOT.

The SEH Team will perform a comparative analysis of the project data collected and existing instrumented data collected on TH 100. The data analysis will also document the data collected and its conformance to the Functional Requirements over the project duration. The data analysis and final report includes the following.

- Data comparison
- Establish possible engineering best practices guidelines for use of project data which could include:
  - Determination of traffic situations where it is best used
  - Identification of any limitations or additional issues that need addressing

### **6.4 Lines of Communication:**

- Email
- Project Meetings
- Meeting Minutes
- Project Deliverables

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## 5.0 Functional Requirements



# Functional Requirements

## Arterial Real-Time Traveler Information (Commercial Probe Data)

Minnesota Department of Transportation  
MnDOT Contract No. 97544

Short Elliott Hendrickson Inc.  
MNTMD 116260

June 2012



Building a Better World  
for All of Us™

Engineers | Architects | Planners | Scientists

# Functional Requirements

## Arterial Real-Time Traveler Information (Commercial Probe Data)

### **I. Project Description**

- 1.1. The project is intended to demonstrate an innovative, non-infrastructure based relatively low-cost approach to collect real time traffic data on metro area arterials to be able to provide real time traffic information to motorists. Data provided will augment traffic data currently being collected by MnDOT and will provide a broader picture of traffic conditions in the metro area.
- 1.2. The project is also intended to be able to confirm the accuracy and reliability of data collected. To do so data will be collected on a MnDOT roadway which is instrumented for a period of up to 6 months to compare against existing traffic data collected by MnDOT's RTMC.
- 1.3. Data will also be collected on three additional, non instrumented arterial routes for a period of up to 6 months.
- 1.4. It is intended to demonstrate the accuracy and reliability of traffic non-infrastructure based data collection on a major state arterial. It will also include a major county arterial, since many of the major arterials in the metro area are county roads, and a rural interstate construction zone.

### **2. Operational Parameters**

- 2.1. Collect data on the following routes:
  - 2.1.1. TH 100 – I-694 to I-494 (15.8 miles)
  - 2.1.2. CSAH 81 – Greenhaven Drive to 36<sup>th</sup> Avenue (6.4 miles)
  - 2.1.3. TH 55 – 7<sup>th</sup> Street N in Minneapolis to end of 4-lane (15.7 miles)
  - 2.1.4. TH 7 – TH 100 to end of 4-lane (12.3 miles)
  - 2.1.5. I-35 – Pine City to Carlton (66 miles)
- 2.2. Collect floating car data from probe vehicles.
- 2.3. Combine real-time, predictive, and historical traffic information as needed to provide travel time information.
  - 2.3.1. The INRIX proprietary Traffic Fusion Engine incorporates a number of advanced numerical and statistical algorithms, including proprietary Bayesian models and Support Vector Machines. These models process the hundreds of data sources aggregated by the INRIX Smart Dust Network and generate accurate real-time, historical and traffic fusion data. The subject of multiple pending patents, the INRIX Fusion Engine is designed specifically to maximize data quality, employing:

- 2.3.1.1. Detection of Malfunctioning Traffic Sensors—particularly in the case of public DOT loop detector and toll-tag reader data, feeds and the physical sensors and communications infrastructure are prone to failures and long-lead repair times. Uniquely, INRIX detects incorrectly functioning sensors in real-time, flagging them to be ignored as a data source for the Traffic Fusion Engine.
- 2.3.1.2. Geospatial Filtering—due to its unique relationships with data suppliers, INRIX obtains location and time information, speed and heading for each vehicle together with additional metadata that provides context for the vehicle’s current status, allowing high accuracy geospatial filtering of probe-derived data.
- 2.3.1.3. Collaborative Filtering and Outlier Detection—INRIX combines data from all sources allowing collaboration between data points that agree with one another to identify statistical outlier points and hence compute a high confidence estimate of real-time conditions together with an error estimate.
- 2.3.1.4. Optimizing Spatial Granularity—due to the high density of raw data that INRIX receives, it is frequently able to determine real-time conditions at or below the resolution of a single road segment. In real-time, the Traffic Fusion Engine is able to adjust the spatial granularity of the data it computes to maximize the statistical confidence in the data.
- 2.3.1.5. Statistically Optimized Estimation—INRIX incorporates proprietary and patented algorithms, using elements of our predictive engine, to evaluate results from our analytical processes before generating a final speed value.
- 2.3.1.6. Eliminate Low Confidence Data—if, due to insufficient data at a given location, INRIX is unable to meet its error threshold for real-time data, no real-time information is reported on the road segment in question.
- 2.3.2. To make useful predictions, the Fusion Engine first determines the combination of factors that will influence future traffic patterns and develops an in-depth understanding of what traffic is like. These include obvious factors such as the day of the week, the weather, accidents and road construction, as well as other events such as school schedules, sports games and concerts. It also applies proprietary error-detection algorithms to road sensor data, so a single unreliable sensor does not lead to an incorrect reading for a particular stretch of road.

### **3. Data Collection Strategy**

- 3.1. Obtain latitude and longitude coordinates for roadway segments.
- 3.2. Collect data 24 hours per day, 7 days per week
- 3.3. Provide the following archived data by roadway segment, as often as once per minute:
  - 3.3.1. Road segment
  - 3.3.2. Roadway name
  - 3.3.3. Time
  - 3.3.4. Average speed in MPH
  - 3.3.5. Travel time along segment in minutes

3.4. Provide data every two weeks for the first month and then monthly.

#### **4. Route Characteristics**

4.1 The routes selected for data on this project shall have the following characteristics.

- 4.1.1. No exclusive lane designations.
- 4.1.2. Data available for comparison from existing sources.
- 4.1.3. Arterial roadway.
- 4.1.4. Peak hour travel concerns.
- 4.1.5. Commercial vehicle traffic.
- 4.1.6. Urban setting.

#### **5. Policy Issues**

5.1. Following is a list of policy issues for MnDOT's consideration when providing arterial travel time information.

- 5.1.1. Selection of routes and end destinations.
- 5.1.2. Location of Changeable Message Signs.
- 5.1.3. Times of day for displaying travel time messages.
- 5.1.4. Other messages for display.
- 5.1.5. Priority of travel time messages over other messages.
- 5.1.6. Publicity and driver education.
- 5.1.7. Travel time display format.
- 5.1.8. Phasing and updating of messages.
- 5.1.9. Maximum and minimum travel times.
- 5.1.10. Travel time ranges.
- 5.1.11. Integrating data into existing system.

#### **6. Evaluation Requirements**

6.1. Compare travel time data on TH 100 to data that is systematically collected by MnDOT.

#### Segment

- 98.5% of the INRIX data results should be less than 4 minutes different than MnDOT's
- 98.0% of the INRIX data results should be less than 3 minutes different than MnDOT's
- 95.0% of the INRIX data results should be less than 2 minutes different than MnDOT's

#### Corridor

- 99.0% of the INRIX data results should be less than 4 minutes different than MnDOT's
- 98.0% of the INRIX data results should be less than 3 minutes different than MnDOT's
- 96.5% of the INRIX data results should be less than 2 minutes different than MnDOT's

- 6.2. Compare travel time data provided on other arterial routes to field collected data. Travel times shall be within 12% of the field collected data, i.e. range for an 8 minute field collected travel time is 7.04 – 8.96 minutes, provided the field collected data has been determined to have been comprised of a statistically significant number of travel time runs. The INRIX data shall also reflect incident/event slow downs.
- 6.3. Thresholds relating to the acceptability of data will be determined to be acceptable, by MnDOT's RTMC upon their review of the evaluations.
- 6.4. Compare the cost of providing travel time information using vehicle probe data to MnDOT's current infrastructure method.

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## **6.0 Probe Data**

- Project Location Details
- Data Sample
- TH 100 Data Comparison



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## Project Location Details

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# Arterial Real-Time Traveler Information (Commercial Probe Data)

## Project Location Details January 17, 2012

### 1. Introduction

This document includes a summary of the project start and end points for the four corridors to be evaluated for the Arterial Real-Time Traveler Information Commercial Probe Data Project. The corridors include:

- TH 100 from I-694 to I-494
- CSAH 81 from Greenhaven Drive to 36th Ave
- TH 55 from Arrowhead Drive to Thomas Ave
- TH 7 from TH 41/Hazeltine Blvd to Joppa Ave

#### Definition of Terms:

For this project, the following definition of terms is recommended:

Corridor-	The stretches of highway that are the focus of this study. Corridors are not used to report travel times or speeds, but rather represent the boundaries of the project.
Project Routes-	Pre-defined portions of the corridors for which the SEH/INRIX team will provide Travel Times, and the Evaluation Team will perform floating car surveys. Each of the Project Routes are defined by start and end points.
TMC Segments-	Traffic Message Channel (TMC) segments are defined by the TMC Location Codes. These are pre-defined segments (not defined by this project, but defined by the industry). These segments do not match directly to the Project Routes. The SEH/INRIX team will provide speeds on TMC Segments (not travel times) in the archived data delivered.

## 2. Summary of Data

The SEH/INRIX Team will provide two distinct data sets, described as follows:

- **Travel time** data for a set of “project routes” defined by this project team. Each “project route” is defined by a starting and ending point at defined locations (i.e. at locations of detector stations on freeways and the center of intersections on the arterials).
- **Speed data** for a set of TMC segments defined by the pre-defined TMC location Codes. Note: in this situation, TMC refers to the Traffic Message Channel. TMC Location Codes result from a location coding approach to defining pre-defined segments of major highways. The TMC Location Codes were developed by TeleAtlas and Navteq, and are used throughout the industry.

The speed data and travel time data will be reported every minute during the data collection period.

The speed data and travel time data will be delivered as archived data at the end of the initial two weeks of data collection, and then at the end of each month, following the initial two weeks.

### 3. Travel Time Data (delivered for “Project Routes”)

#### 3.1 Corridor #1: TH 100 from I-694 to I-494 (15.8 miles)

Project Route ID	Start Point			End Point			Approximate Distance
	Street Name	Lon <sup>1</sup>	Lat <sup>1</sup>	Street Name	Lon <sup>1</sup>	Lat <sup>1</sup>	
TH 100 Northbound							
NB TH 100 – 1	77 <sup>th</sup> Street	-93.34971	44.86399	Cedar Lake Rd	-93.3426	44.96683	
NB TH 100 – 2	77 <sup>th</sup> Street	-93.34971	44.86399	57 <sup>th</sup> Ave	-93.30902	45.05858	
NB TH 100 – 3	Minnetonka Blvd	-93.34768	44.95312	TH 55	-93.34933	44.98689	
NB TH 100 – 4	Minnetonka Blvd	-93.34768	44.95312	57 <sup>th</sup> Ave	-93.30902	45.05858	
NB TH 100 – 5	S of Duluth St	-93.34938	44.99244	42 <sup>nd</sup> Ave	-93.3463	45.03261	
NB TH 100 – 6	S of Duluth St	-93.34938	44.99244	57 <sup>th</sup> Ave	-93.30902	45.05858	
TH 100 Southbound							
SB TH 100 – 1	N of TH 55	-93.34945	44.99091	Minnetonka Blvd	-93.34806	44.947	
SB TH 100 – 2	N of TH 55	-93.34945	44.99091	77 <sup>th</sup> St	-93.35034	44.86518	
SB TH 100 – 3	50 <sup>th</sup> St	-93.35096	44.9126				
SB TH 100 – 4	<i>To be provided by MnDOT</i>						
SB TH 100 – 5	<i>To be provided by MnDOT</i>						
SB TH 100 – 6	<i>To be provided by MnDOT</i>						

<sup>1</sup>NOTE: Latitude and longitude data provided in this document for TH 100 was provided by MnDOT. Locations represent the location of the sensors at the locations identified.

### 3.2 Corridor #2: TH 55 from Arrowhead Dr to Thomas Ave (13.8 miles)

Project Route ID	Start Point			End Point			Approximate Distance
	Street Name	Lon <sup>2</sup>	Lat <sup>2</sup>	Street Name	Lon <sup>2</sup>	Lat <sup>2</sup>	
TH 55 Eastbound							
EB TH 55 – 1	Arrowhead Dr	-93.563537	45.051468	County Road 101/Peony Ln N	-93.507463	45.031963	3.1 miles
EB TH 55 – 2	County Road 101/Peony Ln N	-93.507463	45.031963	I-494 W Ramps	-93.45858	45.011229	2.8 miles
EB TH 55 – 3	I-494 W Ramps	-93.45858	45.011229	General Mills Blvd/Boone Ave	-93.39028	44.984501	4.1 miles
EB TH 55 – 4	General Mills Blvd/Boone Ave	-93.39028	44.984501	Thomas Ave	-93.31337	44.984164	3.8 miles
EB TH 55 – 5	Arrowhead Dr	-93.563537	45.051468	I-494 W Ramps	-93.45858	45.011229	5.9 miles
EB TH 55 – 6	Arrowhead Dr	-93.563537	45.051468	Thomas Ave	-93.31337	44.984164	13.8 miles
TH 55 Westbound							
WB TH 55 - 1	Thomas Ave	-93.313381	44.984375	General Mills Blvd/Boone Ave	-93.390253	44.984715	3.8 miles
WB TH 55 - 2	General Mills Blvd/Boone Ave	-93.390253	44.984715	I-494 W Ramps	-93.458515	45.011457	4.1 miles
WB TH 55 - 3	I-494 W Ramps	-93.458515	45.011457	County Road 101/Peony Ln N	-93.507377	45.032228	2.8 miles
WB TH 55 - 4	County Road 101/Peony Ln N	-93.507377	45.032228	Arrowhead Dr	-93.563521	45.051644	3.1 miles
WB TH 55 - 5	Thomas Ave	-93.313381	44.984375	I-494 W Ramps	-93.458515	45.011457	7.9 miles
WB TH 55 - 6	Thomas Ave	-93.313381	44.984375	Arrowhead Dr	-93.563521	45.051644	13.8 miles

To view a google map of the locations included in the table above, go to:

<http://maps.google.com/maps/ms?ie=UTF&msa=0&msid=205534682214740816662.0004b6a73224b6567f351>

<sup>2</sup>NOTE: The Evaluation Team will perform floating car surveys along routes defined from one intersection to another intersection. The Evaluation Team has provided the names of the intersections where the floating car surveys will begin and end (beginning and ending points are the center of the intersection). The SEH/INRIX team requested that the evaluation team provide latitude and longitude of the starting and ending locations, as no other source was identified. The Evaluation Team does not have a budget for field surveys and therefore performed lat/lon captures from Google maps, with validation from the on-line MnDOT GIS data. Therefore, it is suggested that the SEH/INRIX Team and/or MnDOT review the latitude/longitude values provided to confirm if the values delivered meet the needs of the SEH/INRIX team. If the latitude/longitude values are inputs to the travel time calculations, we feel the SEH/INRIX team should take responsibility for these values as the Evaluation Team does not understand the degree of accuracy that is required, in an effort to allow the evaluation to remain an independent third party evaluation.

### 3.3 Corridor #3: TH 7 from TH 41/Hazeltine Blvd to Joppa Ave (13.0 miles)

Project Route ID	Start Point			End Point			Approximate Distance
	Street Name	Lon <sup>3</sup>	Lat <sup>3</sup>	Street Name	Lon <sup>3</sup>	Lat <sup>3</sup>	
TH 7 Eastbound							
EB TH 7 - 1	TH 41/Hazeltine Blvd	-93.580674	44.891756	Vine Hill Rd	-93.525469	44.910519	3.1 miles
EB TH 7 - 2	Vine Hill Rd	-93.525469	44.910519	Williston Rd	-93.467882	44.921923	3.0 miles
EB TH 7 - 3	Williston Rd	-93.467882	44.921923	Oakridge	-93.40573	44.933586	3.2 miles
EB TH 7 - 4	Oakridge	-93.40573	44.933586	Joppa Ave	-93.333991	44.947207	3.7 miles
EB TH 7 - 5	TH 41/Hazeltine Blvd	-93.580674	44.891756	Williston Rd	-93.467882	44.921923	6.1 miles
EB TH 7 - 6	TH 41/Hazeltine Blvd	-93.580674	44.891756	Joppa Ave	-93.333991	44.947207	13.0 miles
TH 7 Westbound							
WB TH 7 - 1	Joppa Ave	-93.333997	44.947397	Oakridge	-93.405743	44.933689	3.7 miles
WB TH 7 - 2	Oakridge	-93.405743	44.933689	Williston Rd	-93.467898	44.922071	3.2 miles
WB TH 7 - 3	Williston Rd	-93.467898	44.922071	Vine Hill Rd	-93.525517	44.910635	3.0 miles
WB TH 7 - 4	Vine Hill Rd	-93.525517	44.910635	TH 41/Hazeltine Blvd	-93.580685	44.891957	3.1 miles
WB TH 7 - 5	Joppa Ave	-93.333997	44.947397	Williston Rd	-93.467898	44.922071	6.9 miles
WB TH 7 - 6	Joppa Ave	-93.333997	44.947397	Vine Hill Rd	-93.525517	44.910635	13.0 miles

To view a google map of the locations included in the table above, go to:

<http://maps.google.com/maps/ms?ie=UTF&msa=0&msid=205534682214740816662.0004b6ab3644684d6f517>

<sup>3</sup>NOTE: The Evaluation Team will perform floating car surveys along routes defined from one intersection to another intersection. The Evaluation Team has provided the names of the intersections where the floating car surveys will begin and end (beginning and ending points are the center of the intersection). The SEH/INRIX team requested that the evaluation team provide latitude and longitude of the starting and ending locations, as no other source was identified. The Evaluation Team does not have a budget for field surveys and therefore performed lat/lon captures from Google maps, with validation from the on-line MnDOT GIS data. Therefore, it is suggested that the SEH/INRIX Team and/or MnDOT review the latitude/longitude values provided to confirm if the values delivered meet the needs of the SEH/INRIX team. If the latitude/longitude values are inputs to the travel time calculations, we feel the SEH/INRIX team should take responsibility for these values as the Evaluation Team does not understand the degree of accuracy that is required, in an effort to allow the evaluation to remain an independent third party evaluation.

### 3.4 Corridor #4: CSAH 81 from Greenhaven Drive to 36<sup>th</sup> Ave (6.4 miles)

Project Route ID	Start Point			End Point			Approximate Distance
	Street Name	Lon <sup>4</sup>	Lat <sup>4</sup>	Street Name	Lon <sup>4</sup>	Lat <sup>4</sup>	
CSAH 81 Northbound							
NB CSAH 81 – 1	36 <sup>th</sup> Ave	-93.326407	45.020612	Bass Lake Rd	-93.35803	45.05467	3.5 miles
NB CSAH 81 – 2	Bass Lake Rd	-93.35803	45.05467	Greenhaven Drive	-93.388925	45.100847	2.9 miles
NB CSAH 81 – 3	36 <sup>th</sup> Ave	-93.326407	45.020612	Greenhaven Drive	-93.388925	45.100847	6.4 miles
CASH 81 Southbound							
SB CSAH 81 – 1	Greenhaven Drive	-93.389250	45.100756	Bass Lake Rd	-93.358324	45.054658	2.9 miles
SB CSAH 81 – 2	Bass Lake Rd	-93.358324	45.054658	36 <sup>th</sup> Ave	-93.326584	45.020571	3.5 miles
SB CSAH 81 – 3	Greenhaven Drive	-93.389250	45.100756	36 <sup>th</sup> Ave	-93.326584	45.020571	6.4 miles

To view a map of the locations included in the table above, see the screen capture of the google map developed for CSAH 81 on the following page. The map is available at: <http://maps.google.com/maps/ms?ie=UTF&msa=0&msid=205534682214740816662.0004b65a6183aed19b455>

<sup>2</sup>NOTE: Hennepin County will perform floating car surveys along routes defined from one intersection to another intersection. The Evaluation Team has provided the names of the intersections where the floating car surveys will begin and end (beginning and ending points are the center of the intersection). The SEH/INRIX team requested that the evaluation team provide latitude and longitude of the starting and ending locations, as no other source was identified. The Evaluation Team does not have a budget for field surveys and therefore performed lat/lon captures from Google maps, with validation from the on-line MnDOT GIS data. Therefore, it is suggested that the SEH/INRIX Team and/or MnDOT review the latitude/longitude values provided to confirm if the values delivered meet the needs of the SEH/INRIX team. If the latitude/longitude values are inputs to the travel time calculations, we feel the SEH/INRIX team should take responsibility for these values as the Evaluation Team does not understand the degree of accuracy that is required, in an effort to allow the evaluation to remain an independent third party evaluation.

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### CSAH 81 - Green Haven Dr to 36th Ave

Unlisted · 0 views  
Created on Jan 12 · By · Updated < 1 minute ago  
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- SB CSAH 81 - Green Haven Drive  
45.100756,-93.389250
- SB CSAH 81 - Bass Lake Rd/CR 10  
45.054658,-93.358324
- SB CSAH 81 - 36th Ave  
45.020571,-93.326584
- NB CSAH 81 - 36th Ave  
45.020612,-93.326407
- NB CSAH 81 - Bass Lake Rd/ CR 10  
45.05467,-93.35803
- NB CSAH 81 - Green Haven Drive  
45.100847,-93.388925
- Green Haven Drive to 36th Ave  
6.4 miles
- Green Haven Drive to Bass Lake Rd/CR 10  
3.5 miles
- Bass Lake Rd/CR 10 to 36th Ave  
2.9 miles



#### 4. Speed Data (Delivered for TMC Location Code Segments)

TMC	Type	Road Number	FirstName	LinearTMC	Direction	StartLat	StartLong	EndLat	EndLong	Miles
118+04314	P2.0	MN-100	MN-152/Brooklyn Blvd/Xerxes Ave (Minneapolis) (North) (Retired)	11800082	Northbound	45.05089	-93.3221	45.05093	-93.322	0.003356
118+04315	P1.11	MN-100	CR-10/John Martin Dr/57th Ave	11800082	Northbound	45.0532	-93.3187	45.05686	-93.3119	0.420564
118+04316	P1.11	MN-100	I-694/I-94/Humboldt Ave	11800082	Northbound	45.06208	-93.3033	45.06328	-93.3016	0.119433
118+04361	P1.11	MN-100	77th St/Edina Industrial Blvd	11800087	Northbound	44.86212	-93.35	44.86331	-93.35	0.082273
118+04362	P1.11	MN-100	70th St	11800087	Northbound	44.86786	-93.3501	44.87283	-93.3503	0.343386
118+04363	P1.11	MN-100	MN-62	11800087	Northbound	44.8799	-93.3503	44.88524	-93.3501	0.369484
118+04364	P1.11	MN-100	Benton Ave	11800087	Northbound	44.89346	-93.3499	44.89665	-93.3499	0.220908
118+04365	P1.11	MN-100	50th St/Vernon Ave	11800087	Northbound	44.89912	-93.3498	44.90903	-93.3505	0.685591
118+04366	P1.11	MN-100	CR-3/Excelsior Blvd	11800087	Northbound	44.91519	-93.3503	44.92724	-93.3495	0.835969
118+04367	P1.11	MN-100	36th St	11800087	Northbound	44.93035	-93.3499	44.93405	-93.3499	0.255893
118+04368	P1.11	MN-100	MN-7/CR-25	11800087	Northbound	44.93919	-93.3485	44.94138	-93.348	0.153921
118+04369	P1.11	MN-100	CR-5/Minnetonka Blvd	11800087	Northbound	44.94634	-93.3479	44.94921	-93.3478	0.198537
118+04370	P1.11	MN-100	W 25 1-2 St	11800087	Northbound	44.95258	-93.3478	44.95529	-93.3475	0.187539
118+04371	P1.11	MN-100	Cedar Lake Rd/Stephens Dr	11800087	Northbound	44.95529	-93.3475	44.96273	-93.3441	0.540929
118+04372	P1.3	MN-100	I-394	11800087	Northbound	44.96252	-93.3442	44.96273	-93.3441	0.014665
118+04373	P1.11	MN-100	Glenwood Ave	11800087	Northbound	44.97453	-93.3414	44.97648	-93.343	0.15535
118+04374	P1.11	MN-100	MN-55	11800087	Northbound	44.97944	-93.347	44.98088	-93.3481	0.113468
118+04703	P1.11	MN-55	I-94/Lyndale Ave	11800129	Westbound	44.98443	-93.2838	44.98444	-93.2875	0.181076
118+04704	P1.11	MN-55	Penn Ave	11800129	Westbound	44.98444	-93.2886	44.98452	-93.3083	0.963916
118+04705	P1.11	MN-55	Theodore Wirth Pkwy	11800129	Westbound	44.98452	-93.3083	44.98428	-93.3282	0.977835
118+04706	P1.11	MN-55	MN-100	11800129	Westbound	44.98428	-93.3283	44.98453	-93.3465	0.891771
118+04707	P1.11	MN-55	Douglas Dr	11800129	Westbound	44.98471	-93.3511	44.98478	-93.3584	0.355503
118+04708	P1.11	MN-55	Glenwood Ave	11800129	Westbound	44.98468	-93.3602	44.98335	-93.3703	0.505322
118+04709	P1.11	MN-55	Winnetka Ave	11800129	Westbound	44.98335	-93.3703	44.9838	-93.3803	0.491527
118+04710	P1.11	MN-55	General Mills Blvd/Boone Ave	11800129	Westbound	44.98395	-93.381	44.98474	-93.3902	0.45791
118+04711	P1.11	MN-55	US-169	11800129	Westbound	44.98472	-93.3904	44.9839	-93.3953	0.248684
118+04712	P1.11	MN-55	Shore Dr	11800129	Westbound	44.98381	-93.4062	44.98764	-93.4184	0.662226

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118+04713	P1.11	MN-55	CR-6 (Minneapolis)	11800129	Westbound	44.98828	-93.4203	44.99915	-93.4414	1.32905
118+04714	P1.11	MN-55	Northwest Blvd/Xenium Ln	11800129	Westbound	44.99959	-93.4417	45.00773	-93.4493	0.6818
118+04715	P1.3	MN-55	I-494	11800129	Westbound	45.00878	-93.4517	45.01046	-93.4558	0.228613
118+04716	P1.11	MN-55	Vicksburg Ln	11800129	Westbound	45.01167	-93.4593	45.01877	-93.4817	1.207442
118+04717	P1.11	MN-55	CR-24/Rockford Rd	11800129	Westbound	45.01883	-93.4824	45.02215	-93.4927	0.573242
118+04718	P1.11	MN-55	Peony Ln	11800129	Westbound	45.02287	-93.4938	45.03215	-93.5073	0.920542
118+04719	P1.11	MN-55	Old Rockford Rd	11800129	Westbound	45.03273	-93.5081	45.03809	-93.5159	0.532353
118+04720	P1.11	MN-55	CR-101/Sioux Dr	11800129	Westbound	45.03835	-93.5163	45.04329	-93.5243	0.525518
118+04721	P1.11	MN-55	Pinto Dr	11800129	Westbound	45.04357	-93.5256	45.04612	-93.5425	0.843737
118+04722	P1.11	MN-55	CR-19	11800129	Westbound	45.04612	-93.5425	45.06552	-93.6356	4.828713
118+05170	P1.11	MN-7	Oak St	11800183	Eastbound	44.89186	-93.5796	44.89799	-93.5678	0.722875
118+05171	P1.11	MN-7	Division St	11800183	Eastbound	44.89804	-93.5677	44.90031	-93.5623	0.307469
118+05172	P1.11	MN-7	2nd St	11800183	Eastbound	44.90099	-93.5591	44.90117	-93.5564	0.134968
118+05173	P1.11	MN-7	Christmas Lake Rd	11800183	Eastbound	44.90161	-93.5534	44.90208	-93.5509	0.1295
118+05174	P1.11	MN-7	CR-101	11800183	Eastbound	44.90208	-93.5509	44.91321	-93.5045	2.506541
118+05175	P1.11	MN-7	Williston Rd	11800183	Eastbound	44.91387	-93.5026	44.92189	-93.4679	1.802992
118+05176	P1.3	MN-7	I-494	11800183	Eastbound	44.92205	-93.4669	44.92399	-93.4555	0.575851
118+05177	P1.11	MN-7	CR-60/Baker Rd	11800183	Eastbound	44.9259	-93.4469	44.9261	-93.4454	0.074879
118+05178	P1.11	MN-7	Shady Oak Rd	11800183	Eastbound	44.92623	-93.4387	44.92955	-93.4308	0.45791
118+05179	P1.11	MN-7	CR-73/17th Ave	11800183	Eastbound	44.93056	-93.4288	44.93277	-93.4219	0.37806
118+05180	P1.11	MN-7	US-169	11800183	Eastbound	44.93281	-93.4204	44.93396	-93.401	0.952606
118+05181	P1.11	MN-7	Blake Rd/Aquila Ave	11800183	Eastbound	44.93461	-93.3942	44.93535	-93.3871	0.354571
118+05182	P1.11	MN-7	Louisiana Ave	11800183	Eastbound	44.93579	-93.384	44.93761	-93.371	0.647685
118+05183	P1.11	MN-7	MN-100	11800183	Eastbound	44.93788	-93.369	44.94288	-93.3493	1.067938
118+05185	P1.11	CR-25	CR-5/Lake St (Minneapolis) (West)/Minnetonka Blvd	11800184	Eastbound	44.94434	-93.3459	44.94795	-93.3308	0.781286
118+05558	P1.11	CR-81	36th Ave	11800248	Northbound	45.01483	-93.3199	45.0195	-93.3252	0.414971

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118+05559	P1.11	CR-81	France Ave	11800248	Northbound	45.02055	-93.3264	45.02353	-93.3284	0.229297
118+05560	P1.11	CR-81	CR-9/Lake Dr/42nd Ave	11800248	Northbound	45.02353	-93.3284	45.03184	-93.3378	0.738161
118+05561	P1.11	CR-81	MN-100	11800248	Northbound	45.03227	-93.3383	45.03539	-93.342	0.281059
118+05562	P1.11	CR-81	Vera Cruz Ave	11800248	Northbound	45.03708	-93.3434	45.04577	-93.3497	0.676642
118+05563	P1.11	CR-81	CR-10/56th Ave/Bass Lake Rd	11800248	Northbound	45.04577	-93.3497	45.05365	-93.3572	0.654769
118+05564	P1.11	CR-81	63rd Ave	11800248	Northbound	45.05468	-93.3582	45.06923	-93.3678	1.111622
118+05565	P1.3	CR-81	I-94/I-694/US-52	11800248	Northbound	45.06933	-93.3679	45.07563	-93.3719	0.477857
118+05566	P1.11	CR-81	CR-8/71st Ave	11800248	Northbound	45.08118	-93.3756	45.08367	-93.3771	0.186793
118+05567	P1.11	CR-81	MN-152/CR-130/Brooklyn Blvd	11800248	Northbound	45.08379	-93.3772	45.09448	-93.3841	0.812108
118+05568	P1.11	CR-81	US-169	11800248	Northbound	45.09512	-93.3845	45.10554	-93.3921	0.810554
118+05619	P1.11	MN-100	Duluth St	11800087	Northbound	44.98897	-93.3493	44.99545	-93.3493	0.447905
118+05620	P1.11	MN-100	36th Ave	11800087	Northbound	45.00361	-93.3492	45.01683	-93.3493	0.913334
118+05621	P1.11	MN-100	CR-9/42nd Ave	11800087	Northbound	45.02542	-93.3474	45.02818	-93.3473	0.191143
118+05622	P1.11	MN-100	CR-81	11800087	Northbound	45.03132	-93.347	45.03654	-93.3426	0.422366
118+05623	P1.11	MN-100	France Ave	11800087	Northbound	45.03871	-93.3394	45.04028	-93.3347	0.253345
118+06123	P1.3	I-35	CR-11/Exit 171	11800158	Northbound	45.82518	-92.9839	45.84286	-92.9777	1.26225
118+06124	P1.3	I-35	CR-14/Exit 175	11800158	Northbound	45.85042	-92.9739	45.90029	-92.9666	3.47027
118+06125	P1.3	I-35	CR-61/Exit 180	11800158	Northbound	45.90807	-92.9666	45.9737	-92.9564	4.576549
118+06126	P1.3	I-35	MN-48/Exit 183	11800158	Northbound	45.97973	-92.9545	46.01079	-92.9319	2.446763
118+06127	P1.3	I-35	MN-123/Exit 191	11800158	Northbound	46.01108	-92.9318	46.12184	-92.8877	8.045577
118+06128	P1.3	I-35	MN-23/Exit 195	11800158	Northbound	46.12865	-92.8877	46.17703	-92.8583	3.785631
118+06129	P1.3	I-35	CR-43/Exit 205	11800158	Northbound	46.18312	-92.8545	46.31375	-92.8276	9.381524
118+06130	P1.3	I-35	CR-46/Exit 209	11800158	Northbound	46.31979	-92.8272	46.37219	-92.7923	3.989947
118+06131	P1.3	I-35	MN-73/Exit 214	11800158	Northbound	46.37793	-92.7873	46.43226	-92.7477	4.258268
118+06132	P1.3	I-35	MN-27/Exit 216	11800158	Northbound	46.4401	-92.7426	46.45304	-92.7297	1.091116
118+06133	P1.3	I-35	CR-6/Exit 220	11800158	Northbound	46.45313	-92.7296	46.50271	-92.6779	4.308539
118+06134	P1.3	I-35	CR-4/Exit 227	11800158	Northbound	46.50784	-92.6723	46.57286	-92.5853	6.202504

### *Speed Data (Delivered for TMC Location Code Segments) - Continued*

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118+06135	P1.3	I-35	MN-210/Exit 235	11800158	Northbound	46.58217	-92.5848	46.66155	-92.4795	7.623894
118+06136	P1.3	I-35	MN-33/Exit 237	11800158	Northbound	46.6657	-92.4742	46.6847	-92.4597	1.508635
118+06281	P1.11	MN-100	MN-152/Brooklyn Blvd/Xerxes Ave (Minneapolis) (South)	11800087	Northbound	45.04625	-93.3263	45.05093	-93.322	0.384647
118+07977	P1.1	MN-23	I-35/CR-61	11800563	Northbound	46.0145	-92.9301	46.12184	-92.8877	7.796147
118+15896	P1.11	CR-101	MN-55 (Hamel)	11800224	Northbound	45.03835	-93.5163	45.04319	-93.524	0.50613
118+16539	P1.3	NULL	I-494	11801252	Northbound	44.82644	-93.3503	44.85599	-93.3501	2.044157
118-04314	P2.0	MN-100	MN-152/Brooklyn Blvd/Xerxes Ave (Minneapolis) (North) (Retired)	11800082	Southbound	45.05662	-93.3126	45.05475	-93.3162	0.215502
118-04315	P1.11	MN-100	CR-10/John Martin Dr/57th Ave	11800082	Southbound	45.06585	-93.2999	45.06367	-93.3015	0.170326
118-04360	P1.3	MN-100	I-494/MN-5	11800087	Southbound	44.8637	-93.3502	44.86174	-93.3502	0.134968
118-04361	P1.11	MN-100	77th St/Edina Industrial Blvd	11800087	Southbound	44.87289	-93.3505	44.86805	-93.3503	0.334251
118-04362	P1.11	MN-100	70th St	11800087	Southbound	44.8862	-93.3503	44.88097	-93.3505	0.361593
118-04363	P1.11	MN-100	MN-62	11800087	Southbound	44.89665	-93.3501	44.89452	-93.3502	0.14752
118-04364	P1.11	MN-100	Benton Ave	11800087	Southbound	44.90734	-93.3504	44.89994	-93.35	0.512034
118-04365	P1.11	MN-100	50th St/Vernon Ave	11800087	Southbound	44.92689	-93.3496	44.91643	-93.3503	0.72536
118-04366	P1.11	MN-100	CR-3/Excelsior Blvd	11800087	Southbound	44.93405	-93.3501	44.9303	-93.35	0.259
118-04367	P1.11	MN-100	36th St	11800087	Southbound	44.94389	-93.348	44.93934	-93.3487	0.316665
118-04368	P1.11	MN-100	MN-7/CR-25	11800087	Southbound	44.94586	-93.348	44.94561	-93.348	0.017089
118-04369	P1.11	MN-100	CR-5/Minnetonka Blvd	11800087	Southbound	44.95539	-93.3476	44.95106	-93.348	0.299763
118-04370	P1.11	MN-100	W 25 1-2 St	11800087	Southbound	44.95932	-93.3456	44.95539	-93.3476	0.288578
118-04371	P1.11	MN-100	Cedar Lake Rd/Stephens Dr	11800087	Southbound	44.97033	-93.341	44.96891	-93.3416	0.101599
118-04372	P1.3	MN-100	I-394	11800087	Southbound	44.97625	-93.343	44.97528	-93.3422	0.079229
118-04373	P1.11	MN-100	Glenwood Ave	11800087	Southbound	44.98028	-93.348	44.97926	-93.3471	0.082708
118-04374	P1.11	MN-100	MN-55	11800087	Southbound	44.99473	-93.3496	44.98852	-93.3496	0.429325
118-04702	P1.11	MN-55	7th St	11800129	Eastbound	44.98426	-93.2875	44.98421	-93.2835	0.194001
118-04703	P1.11	MN-55	I-94/Lyndale Ave	11800129	Eastbound	44.98427	-93.3083	44.98425	-93.2906	0.867039

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118-04704	P1.11	MN-55	Penn Ave	11800129	Eastbound	44.98408	-93.3282	44.98427	-93.3083	0.978146
118-04705	P1.11	MN-55	Theodore Wirth Pkwy	11800129	Eastbound	44.98437	-93.3468	44.98408	-93.3284	0.902335
118-04706	P1.11	MN-55	MN-100	11800129	Eastbound	44.98461	-93.3582	44.98455	-93.3515	0.331641
118-04707	P1.11	MN-55	Douglas Dr	11800129	Eastbound	44.98315	-93.3702	44.98448	-93.3602	0.499792
118-04708	P1.11	MN-55	Glenwood Ave	11800129	Eastbound	44.98349	-93.3798	44.98315	-93.3702	0.470959
118-04709	P1.11	MN-55	Winnetka Ave	11800129	Eastbound	44.98452	-93.3902	44.98362	-93.3804	0.488545
118-04710	P1.11	MN-55	General Mills Blvd/Boone Ave	11800129	Eastbound	44.98354	-93.3962	44.98426	-93.3918	0.223083
118-04711	P1.11	MN-55	US-169	11800129	Eastbound	44.98774	-93.4193	44.98352	-93.4055	0.74307
118-04712	P1.11	MN-55	Shore Dr	11800129	Eastbound	44.99912	-93.4417	44.98824	-93.4211	1.310843
118-04713	P1.11	MN-55	CR-6 (Minneapolis)	11800129	Eastbound	45.00794	-93.4504	44.99949	-93.442	0.725733
118-04714	P1.11	MN-55	Northwest Blvd/Xenium Ln	11800129	Eastbound	45.00963	-93.4544	45.00904	-93.453	0.079042
118-04715	P1.3	MN-55	I-494	11800129	Eastbound	45.01839	-93.4804	45.01125	-93.4586	1.1824
118-04716	P1.11	MN-55	Vicksburg Ln	11800129	Eastbound	45.02149	-93.4922	45.01867	-93.4833	0.492957
118-04717	P1.11	MN-55	CR-24/Rockford Rd	11800129	Eastbound	45.03147	-93.5067	45.02209	-93.4931	0.929863
118-04719	P1.11	MN-55	Old Rockford Rd	11800129	Eastbound	45.04333	-93.5253	45.03821	-93.5165	0.567835
118-04720	P1.11	MN-55	CR-101/Sioux Dr	11800129	Eastbound	45.04598	-93.5425	45.04336	-93.5256	0.84933
118-04721	P1.11	MN-55	Pinto Dr	11800129	Eastbound	45.0654	-93.6356	45.04598	-93.5425	4.831385
118-05169	P1.11	MN-7	MN-41	11800183	Westbound	44.89782	-93.5687	44.89196	-93.5806	0.718401
118-05170	P1.11	MN-7	Oak St	11800183	Westbound	44.90039	-93.5624	44.89874	-93.5665	0.230167
118-05171	P1.11	MN-7	Division St	11800183	Westbound	44.90126	-93.5563	44.90108	-93.5591	0.136584
118-05172	P1.11	MN-7	2nd St	11800183	Westbound	44.9022	-93.5509	44.9017	-93.5535	0.130618
118-05173	P1.11	MN-7	Christmas Lake Rd	11800183	Westbound	44.91361	-93.5039	44.9022	-93.5509	2.541402
118-05174	P1.11	MN-7	CR-101	11800183	Westbound	44.92203	-93.4679	44.91426	-93.502	1.768815
118-05175	P1.11	MN-7	Williston Rd	11800183	Westbound	44.92388	-93.4566	44.92222	-93.4667	0.510667
118-05176	P1.3	MN-7	I-494	11800183	Westbound	44.92599	-93.4474	44.92592	-93.4477	0.014976
118-05177	P1.11	MN-7	CR-60/Baker Rd	11800183	Westbound	44.93036	-93.4295	44.92637	-93.4436	0.773829
118-05178	P1.11	MN-7	Shady Oak Rd	11800183	Westbound	44.9329	-93.4218	44.93087	-93.4285	0.360536

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118-05179	P1.11	MN-7	CR-73/17th Ave	11800183	Westbound	44.93422	-93.4003	44.93292	-93.4203	0.986907
118-05180	P1.11	MN-7	US-169	11800183	Westbound	44.93529	-93.3887	44.93479	-93.394	0.262355
118-05181	P1.11	MN-7	Blake Rd/Aquila Ave	11800183	Westbound	44.93782	-93.3704	44.93569	-93.3858	0.768423
118-05182	P1.11	MN-7	Louisiana Ave	11800183	Westbound	44.94244	-93.3502	44.93801	-93.369	1.014684
118-05184	P1.11	CR-25	MN-100	11800184	Westbound	44.94818	-93.3315	44.94471	-93.3447	0.690624
			Lowry Ave/Oakdale Ave/Theodore							
118-05557	P1.11	CR-81	Wirth Pkwy	11800248	Southbound	45.02054	-93.3265	45.01276	-93.3184	0.670863
118-05558	P1.11	CR-81	36th Ave	11800248	Southbound	45.02344	-93.3285	45.02139	-93.3273	0.154294
118-05559	P1.11	CR-81	France Ave	11800248	Southbound	45.03179	-93.3379	45.02344	-93.3285	0.74015
118-05560	P1.11	CR-81	CR-9/Lake Dr/42nd Ave	11800248	Southbound	45.03531	-93.3421	45.03222	-93.3384	0.280749
118-05561	P1.11	CR-81	MN-100	11800248	Southbound	45.04569	-93.3499	45.03961	-93.3453	0.477608
118-05562	P1.11	CR-81	Vera Cruz Ave	11800248	Southbound	45.05453	-93.3582	45.04569	-93.3499	0.734246
118-05563	P1.11	CR-81	CR-10/56th Ave/Bass Lake Rd	11800248	Southbound	45.06838	-93.3675	45.05544	-93.359	0.985727
118-05564	P1.11	CR-81	63rd Ave	11800248	Southbound	45.07612	-93.3725	45.07007	-93.3686	0.460395
118-05565	P1.3	CR-81	I-94/I-694/US-52	11800248	Southbound	45.08364	-93.3774	45.0796	-93.3748	0.306537
118-05566	P1.11	CR-81	CR-8/71st Ave	11800248	Southbound	45.09448	-93.3844	45.08377	-93.3775	0.813661
118-05567	P1.11	CR-81	MN-152/CR-130/Brooklyn Blvd	11800248	Southbound	45.10474	-93.3919	45.09461	-93.3845	0.789675
118-05619	P1.11	MN-100	Duluth St	11800087	Southbound	45.01536	-93.3495	45.00354	-93.3494	0.816582
118-05620	P1.11	MN-100	36th Ave	11800087	Southbound	45.02777	-93.3476	45.02437	-93.3479	0.236194
118-05621	P1.11	MN-100	CR-9/42nd Ave	11800087	Southbound	45.03444	-93.3451	45.03221	-93.3469	0.177658
118-05622	P1.11	MN-100	CR-81	11800087	Southbound	45.04	-93.3361	45.03837	-93.3404	0.240233
118-05623	P1.11	MN-100	France Ave	11800087	Southbound	45.04895	-93.324	45.04568	-93.327	0.269253
118-06122	P1.3	I-35	MN-324/CR-7/Exit 169	11800158	Southbound	45.84236	-92.9782	45.82465	-92.9842	1.262747
118-06123	P1.3	I-35	CR-11/Exit 171	11800158	Southbound	45.89997	-92.967	45.85228	-92.9735	3.309141
118-06124	P1.3	I-35	CR-14/Exit 175	11800158	Southbound	45.97307	-92.9568	45.90767	-92.9671	4.566793
118-06125	P1.3	I-35	CR-61/Exit 180	11800158	Southbound	46.00754	-92.9338	45.97876	-92.9553	2.280662
118-06126	P1.3	I-35	MN-48/Exit 183	11800158	Southbound	46.12162	-92.888	46.01109	-92.9321	8.017924

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118-06127	P1.3	I-35	MN-123/Exit 191	11800158	Southbound	46.1767	-92.8589	46.12783	-92.8879	3.822356
118-06128	P1.3	I-35	MN-23/Exit 195	11800158	Southbound	46.31451	-92.8281	46.18209	-92.8556	9.501641
118-06129	P1.3	I-35	CR-43/Exit 205	11800158	Southbound	46.37201	-92.7929	46.32013	-92.8275	3.954155
118-06130	P1.3	I-35	CR-46/Exit 209	11800158	Southbound	46.4334	-92.7474	46.3778	-92.7877	4.352348
118-06131	P1.3	I-35	MN-73/Exit 214	11800158	Southbound	46.45244	-92.7305	46.44006	-92.743	1.047245
118-06132	P1.3	I-35	MN-27/Exit 216	11800158	Southbound	46.50266	-92.679	46.45313	-92.73	4.28039
118-06133	P1.3	I-35	CR-6/Exit 220	11800158	Southbound	46.57221	-92.5859	46.50827	-92.6722	6.104074
118-06134	P1.3	I-35	CR-4/Exit 227	11800158	Southbound	46.6612	-92.4804	46.58154	-92.5853	7.659066
118-06135	P1.3	I-35	MN-210/Exit 235	11800158	Southbound	46.68587	-92.4596	46.66631	-92.4739	1.540202
118-06281	P1.11	MN-100	MN-152/Brooklyn Blvd/Xerxes Ave (Minneapolis) (South)	11800087	Southbound	45.05542	-93.3149	45.05475	-93.3162	0.078731
118-07976	P1.3	MN-23	I-35/MN-48/Fire Monument Rd	11800563	Southbound	46.12162	-92.888	46.01379	-92.9307	7.82007
118-15894	P1.11	CR-101	MN-55 (Minneapolis)	11800224	Southbound	45.03796	-93.5162	45.03244	-93.5082	0.546273
118-16538	P1.11	NULL	W 98th St	11801252	Southbound	44.85545	-93.3503	44.8264	-93.3505	2.01054
118N04314	P2.0	MN-100	MN-152/Brooklyn Blvd/Xerxes Ave (Minneapolis) (North) (Retired)	11800082	Southbound	45.05475	-93.3162	45.04895	-93.324	0.562305
118N04315	P1.11	MN-100	CR-10/John Martin Dr/57th Ave	11800082	Southbound	45.06367	-93.3015	45.05662	-93.3126	0.733376
118N04360	P1.3	MN-100	I-494/MN-5	11800087	Southbound	44.86174	-93.3502	44.85545	-93.3503	0.434545
118N04361	P1.11	MN-100	77th St/Edina Industrial Blvd	11800087	Southbound	44.86805	-93.3503	44.8637	-93.3502	0.30082
118N04362	P1.11	MN-100	70th St	11800087	Southbound	44.88097	-93.3505	44.87289	-93.3505	0.557955
118N04363	P1.11	MN-100	MN-62	11800087	Southbound	44.89452	-93.3502	44.8862	-93.3503	0.57436
118N04364	P1.11	MN-100	Benton Ave	11800087	Southbound	44.89994	-93.35	44.89665	-93.3501	0.226997
118N04365	P1.11	MN-100	50th St/Vernon Ave	11800087	Southbound	44.91643	-93.3503	44.90734	-93.3504	0.630907
118N04366	P1.11	MN-100	CR-3/Excelsior Blvd	11800087	Southbound	44.9303	-93.35	44.92689	-93.3496	0.236629
118N04367	P1.11	MN-100	36th St	11800087	Southbound	44.93934	-93.3487	44.93405	-93.3501	0.375698
118N04368	P1.11	MN-100	MN-7/CR-25	11800087	Southbound	44.94561	-93.348	44.94389	-93.348	0.11906
118N04369	P1.11	MN-100	CR-5/Minnetonka Blvd	11800087	Southbound	44.95106	-93.348	44.94586	-93.348	0.359231

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118N04371	P1.11	MN-100	Cedar Lake Rd/Stephens Dr	11800087	Southbound	44.96891	-93.3416	44.95932	-93.3456	0.694166
118N04372	P1.3	MN-100	I-394	11800087	Southbound	44.97528	-93.3422	44.96685	-93.3428	0.609469
118N04373	P1.11	MN-100	Glenwood Ave	11800087	Southbound	44.97926	-93.3471	44.97396	-93.3414	0.467169
118N04374	P1.11	MN-100	MN-55	11800087	Southbound	44.98852	-93.3496	44.98028	-93.348	0.578026
118N04703	P1.11	MN-55	I-94/Lyndale Ave	11800129	Eastbound	44.98425	-93.2906	44.98426	-93.2875	0.152554
118N04705	P1.11	MN-55	Theodore Wirth Pkwy	11800129	Eastbound	44.98408	-93.3284	44.98408	-93.3282	0.008265
118N04706	P1.11	MN-55	MN-100	11800129	Eastbound	44.98455	-93.3515	44.98437	-93.3468	0.231161
118N04707	P1.11	MN-55	Douglas Dr	11800129	Eastbound	44.98448	-93.3602	44.98461	-93.3582	0.097125
118N04709	P1.11	MN-55	Winnetka Ave	11800129	Eastbound	44.98362	-93.3804	44.98349	-93.3798	0.033928
118N04710	P1.11	MN-55	General Mills Blvd/Boone Ave	11800129	Eastbound	44.98426	-93.3918	44.98452	-93.3902	0.081652
118N04711	P1.11	MN-55	US-169	11800129	Eastbound	44.98352	-93.4055	44.98354	-93.3962	0.461762
118N04712	P1.11	MN-55	Shore Dr	11800129	Eastbound	44.98824	-93.4211	44.98774	-93.4193	0.096068
118N04713	P1.11	MN-55	CR-6 (Minneapolis)	11800129	Eastbound	44.99949	-93.442	44.99912	-93.4417	0.028709
118N04714	P1.11	MN-55	Northwest Blvd/Xenium Ln	11800129	Eastbound	45.00904	-93.453	45.00794	-93.4504	0.150255
118N04715	P1.3	MN-55	I-494	11800129	Eastbound	45.01125	-93.4586	45.00963	-93.4544	0.233895
118N04716	P1.11	MN-55	Vicksburg Ln	11800129	Eastbound	45.01867	-93.4833	45.01839	-93.4804	0.140685
118N04717	P1.11	MN-55	CR-24/Rockford Rd	11800129	Eastbound	45.02209	-93.4931	45.02149	-93.4922	0.059157
118N04718	P1.11	MN-55	Peony Ln	11800129	Eastbound	45.03198	-93.5074	45.03147	-93.5067	0.050085
118N04719	P1.11	MN-55	Old Rockford Rd	11800129	Eastbound	45.03821	-93.5165	45.03796	-93.5162	0.024607
118N04720	P1.11	MN-55	CR-101/Sioux Dr	11800129	Eastbound	45.04336	-93.5256	45.04333	-93.5253	0.010067
118N05170	P1.11	MN-7	Oak St	11800183	Westbound	44.89874	-93.5665	44.89782	-93.5687	0.128071
118N05171	P1.11	MN-7	Division St	11800183	Westbound	44.90108	-93.5591	44.90039	-93.5624	0.169332
118N05172	P1.11	MN-7	2nd St	11800183	Westbound	44.9017	-93.5535	44.90126	-93.5563	0.141369
118N05174	P1.11	MN-7	CR-101	11800183	Westbound	44.91426	-93.502	44.91361	-93.5039	0.102966
118N05175	P1.11	MN-7	Williston Rd	11800183	Westbound	44.92222	-93.4667	44.92203	-93.4679	0.060897
118N05176	P1.3	MN-7	I-494	11800183	Westbound	44.92592	-93.4477	44.92388	-93.4566	0.459028
118N05177	P1.11	MN-7	CR-60/Baker Rd	11800183	Westbound	44.92637	-93.4436	44.92599	-93.4474	0.185736

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118N05178	P1.11	MN-7	Shady Oak Rd	11800183	Westbound	44.93087	-93.4285	44.93036	-93.4295	0.060711
118N05179	P1.11	MN-7	CR-73/17th Ave	11800183	Westbound	44.93292	-93.4203	44.9329	-93.4218	0.072331
118N05180	P1.11	MN-7	US-169	11800183	Westbound	44.93479	-93.394	44.93422	-93.4003	0.314553
118N05181	P1.11	MN-7	Blake Rd/Aquila Ave	11800183	Westbound	44.93569	-93.3858	44.93529	-93.3887	0.144227
118N05182	P1.11	MN-7	Louisiana Ave	11800183	Westbound	44.93801	-93.369	44.93782	-93.3704	0.070405
118N05183	P1.11	MN-7	MN-100	11800183	Westbound	44.94471	-93.3447	44.94244	-93.3502	0.317473
118N05558	P1.11	CR-81	36th Ave	11800248	Southbound	45.02139	-93.3273	45.02054	-93.3265	0.069659
118N05560	P1.11	CR-81	CR-9/Lake Dr/42nd Ave	11800248	Southbound	45.03222	-93.3384	45.03179	-93.3379	0.038713
118N05561	P1.11	CR-81	MN-100	11800248	Southbound	45.03961	-93.3453	45.03531	-93.3421	0.334872
118N05563	P1.11	CR-81	CR-10/56th Ave/Bass Lake Rd	11800248	Southbound	45.05544	-93.359	45.05453	-93.3582	0.073574
118N05564	P1.11	CR-81	63rd Ave	11800248	Southbound	45.07007	-93.3686	45.06838	-93.3675	0.128443
118N05565	P1.3	CR-81	I-94/I-694/US-52	11800248	Southbound	45.0796	-93.3748	45.07612	-93.3725	0.264654
118N05566	P1.11	CR-81	CR-8/71st Ave	11800248	Southbound	45.08377	-93.3775	45.08364	-93.3774	0.00957
118N05567	P1.11	CR-81	MN-152/CR-130/Brooklyn Blvd	11800248	Southbound	45.09461	-93.3845	45.09448	-93.3844	0.00988
118N05568	P1.11	CR-81	US-169	11800248	Southbound	45.10747	-93.3937	45.10474	-93.3919	0.208604
118N05619	P1.11	MN-100	Duluth St	11800087	Southbound	45.00354	-93.3494	44.99473	-93.3496	0.608102
118N05620	P1.11	MN-100	36th Ave	11800087	Southbound	45.02437	-93.3479	45.01536	-93.3495	0.629478
118N05621	P1.11	MN-100	CR-9/42nd Ave	11800087	Southbound	45.03221	-93.3469	45.02777	-93.3476	0.309706
118N05622	P1.11	MN-100	CR-81	11800087	Southbound	45.03837	-93.3404	45.03444	-93.3451	0.357119
118N05623	P1.11	MN-100	France Ave	11800087	Southbound	45.04568	-93.327	45.04	-93.3361	0.607356
118N06122	P1.3	I-35	MN-324/CR-7/Exit 169	11800158	Southbound	45.82465	-92.9842	45.81841	-92.9838	0.431997
118N06123	P1.3	I-35	CR-11/Exit 171	11800158	Southbound	45.85228	-92.9735	45.84236	-92.9782	0.721694
118N06124	P1.3	I-35	CR-14/Exit 175	11800158	Southbound	45.90767	-92.9671	45.89997	-92.967	0.532167
118N06125	P1.3	I-35	CR-61/Exit 180	11800158	Southbound	45.97876	-92.9553	45.97307	-92.9568	0.400244
118N06126	P1.3	I-35	MN-48/Exit 183	11800158	Southbound	46.01109	-92.9321	46.00754	-92.9338	0.258751
118N06127	P1.3	I-35	MN-123/Exit 191	11800158	Southbound	46.12783	-92.8879	46.12162	-92.888	0.429387
118N06128	P1.3	I-35	MN-23/Exit 195	11800158	Southbound	46.18209	-92.8556	46.1767	-92.8589	0.405588

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118N06129	P1.3	I-35	CR-43/Exit 205	11800158	Southbound	46.32013	-92.8275	46.31451	-92.8281	0.391358
118N06130	P1.3	I-35	CR-46/Exit 209	11800158	Southbound	46.3778	-92.7877	46.37201	-92.7929	0.470089
118N06131	P1.3	I-35	MN-73/Exit 214	11800158	Southbound	46.44006	-92.743	46.4334	-92.7474	0.504763
118N06132	P1.3	I-35	MN-27/Exit 216	11800158	Southbound	46.45313	-92.73	46.45244	-92.7305	0.054994
118N06133	P1.3	I-35	CR-6/Exit 220	11800158	Southbound	46.50827	-92.6722	46.50266	-92.679	0.511102
118N06134	P1.3	I-35	CR-4/Exit 227	11800158	Southbound	46.58154	-92.5853	46.57221	-92.5859	0.646877
118N06135	P1.3	I-35	MN-210/Exit 235	11800158	Southbound	46.66631	-92.4739	46.6612	-92.4804	0.470089
118N06136	P1.3	I-35	MN-33/Exit 237	11800158	Southbound	46.69319	-92.4497	46.68587	-92.4596	0.719519
118N15894	P1.11	CR-101	MN-55 (Minneapolis) MN-152/Brooklyn Blvd/Xerxes Ave	11800224	Southbound	45.03244	-93.5082	45.03198	-93.5074	0.047661
118P04314	P2.0	MN-100	(Minneapolis) (North) (Retired)	11800082	Northbound	45.05093	-93.322	45.0532	-93.3187	0.226252
118P04315	P1.11	MN-100	CR-10/John Martin Dr/57th Ave	11800082	Northbound	45.05686	-93.3119	45.06208	-93.3033	0.552176
118P04360	P1.3	MN-100	I-494/MN-5	11800087	Northbound	44.85599	-93.3501	44.86212	-93.35	0.423484
118P04361	P1.11	MN-100	77th St/Edina Industrial Blvd	11800087	Northbound	44.86331	-93.35	44.86786	-93.3501	0.313807
118P04362	P1.11	MN-100	70th St	11800087	Northbound	44.87283	-93.3503	44.8799	-93.3503	0.488296
118P04363	P1.11	MN-100	MN-62	11800087	Northbound	44.88524	-93.3501	44.89346	-93.3499	0.567276
118P04364	P1.11	MN-100	Benton Ave	11800087	Northbound	44.89665	-93.3499	44.89912	-93.3498	0.170574
118P04365	P1.11	MN-100	50th St/Vernon Ave	11800087	Northbound	44.90903	-93.3505	44.91519	-93.3503	0.426902
118P04366	P1.11	MN-100	CR-3/Excelsior Blvd	11800087	Northbound	44.92724	-93.3495	44.93035	-93.3499	0.215874
118P04367	P1.11	MN-100	36th St	11800087	Northbound	44.93405	-93.3499	44.93919	-93.3485	0.363954
118P04368	P1.11	MN-100	MN-7/CR-25	11800087	Northbound	44.94138	-93.348	44.94634	-93.3479	0.342267
118P04369	P1.11	MN-100	CR-5/Minnetonka Blvd	11800087	Northbound	44.94921	-93.3478	44.95258	-93.3478	0.232714
118P04371	P1.11	MN-100	Cedar Lake Rd/Stephens Dr	11800087	Northbound	44.96273	-93.3441	44.96772	-93.342	0.360288
118P04372	P1.3	MN-100	I-394	11800087	Northbound	44.96273	-93.3441	44.97453	-93.3414	0.84672
118P04373	P1.11	MN-100	Glenwood Ave	11800087	Northbound	44.97648	-93.343	44.97944	-93.347	0.283731
118P04374	P1.11	MN-100	MN-55	11800087	Northbound	44.98088	-93.3481	44.98897	-93.3493	0.563858
118P04703	P1.11	MN-55	I-94/Lyndale Ave	11800129	Westbound	44.98444	-93.2875	44.98444	-93.2886	0.053192

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118P04705	P1.11	MN-55	Theodore Wirth Pkwy	11800129	Westbound	44.98428	-93.3282	44.98428	-93.3283	0.007519
118P04706	P1.11	MN-55	MN-100	11800129	Westbound	44.98453	-93.3465	44.98471	-93.3511	0.228427
118P04707	P1.11	MN-55	Douglas Dr	11800129	Westbound	44.98478	-93.3584	44.98468	-93.3602	0.089109
118P04709	P1.11	MN-55	Winnetka Ave	11800129	Westbound	44.9838	-93.3803	44.98395	-93.381	0.03803
118P04710	P1.11	MN-55	General Mills Blvd/Boone Ave	11800129	Westbound	44.98474	-93.3902	44.98472	-93.3904	0.009507
118P04711	P1.11	MN-55	US-169	11800129	Westbound	44.9839	-93.3953	44.98381	-93.4062	0.539997
118P04712	P1.11	MN-55	Shore Dr	11800129	Westbound	44.98764	-93.4184	44.98828	-93.4203	0.10657
118P04713	P1.11	MN-55	CR-6 (Minneapolis)	11800129	Westbound	44.99915	-93.4414	44.99959	-93.4417	0.033991
118P04714	P1.11	MN-55	Northwest Blvd/Xenium Ln	11800129	Westbound	45.00773	-93.4493	45.00878	-93.4517	0.140809
118P04715	P1.3	MN-55	I-494	11800129	Westbound	45.01046	-93.4558	45.01167	-93.4593	0.19077
118P04716	P1.11	MN-55	Vicksburg Ln	11800129	Westbound	45.01877	-93.4817	45.01883	-93.4824	0.037346
118P04717	P1.11	MN-55	CR-24/Rockford Rd	11800129	Westbound	45.02215	-93.4927	45.02287	-93.4938	0.07084
118P04718	P1.11	MN-55	Peony Ln	11800129	Westbound	45.03215	-93.5073	45.03273	-93.5081	0.057852
118P04719	P1.11	MN-55	Old Rockford Rd	11800129	Westbound	45.03809	-93.5159	45.03835	-93.5163	0.025229
118P04720	P1.11	MN-55	CR-101/Sioux Dr	11800129	Westbound	45.04329	-93.5243	45.04357	-93.5256	0.066552
118P05169	P1.11	MN-7	MN-41	11800183	Eastbound	44.89174	-93.5806	44.89186	-93.5796	0.048904
118P05170	P1.11	MN-7	Oak St	11800183	Eastbound	44.89799	-93.5678	44.89804	-93.5677	0.006276
118P05171	P1.11	MN-7	Division St	11800183	Eastbound	44.90031	-93.5623	44.90099	-93.5591	0.165976
118P05172	P1.11	MN-7	2nd St	11800183	Eastbound	44.90117	-93.5564	44.90161	-93.5534	0.146464
118P05174	P1.11	MN-7	CR-101	11800183	Eastbound	44.91321	-93.5045	44.91387	-93.5026	0.102096
118P05175	P1.11	MN-7	Williston Rd	11800183	Eastbound	44.92189	-93.4679	44.92205	-93.4669	0.050333
118P05176	P1.3	MN-7	I-494	11800183	Eastbound	44.92399	-93.4555	44.9259	-93.4469	0.44486
118P05177	P1.11	MN-7	CR-60/Baker Rd	11800183	Eastbound	44.9261	-93.4454	44.92623	-93.4387	0.325241
118P05178	P1.11	MN-7	Shady Oak Rd	11800183	Eastbound	44.92955	-93.4308	44.93056	-93.4288	0.119247
118P05179	P1.11	MN-7	CR-73/17th Ave	11800183	Eastbound	44.93277	-93.4219	44.93281	-93.4204	0.073015
118P05180	P1.11	MN-7	US-169	11800183	Eastbound	44.93396	-93.401	44.93461	-93.3942	0.339347
118P05181	P1.11	MN-7	Blake Rd/Aquila Ave	11800183	Eastbound	44.93535	-93.3871	44.93579	-93.384	0.154729

***Speed Data (Delivered for TMC Location Code Segments) - Continued***

<b>TMC</b>	<b>Type</b>	<b>Road Number</b>	<b>FirstName</b>	<b>LinearTMC</b>	<b>Direction</b>	<b>StartLat</b>	<b>StartLong</b>	<b>EndLat</b>	<b>EndLong</b>	<b>Miles</b>
118P05182	P1.11	MN-7	Louisiana Ave	11800183	Eastbound	44.93761	-93.371	44.93788	-93.369	0.102593
118P05183	P1.11	MN-7	MN-100	11800183	Eastbound	44.94288	-93.3493	44.94434	-93.3459	0.198413
118P05558	P1.11	CR-81	36th Ave	11800248	Northbound	45.0195	-93.3252	45.02055	-93.3264	0.091967
118P05560	P1.11	CR-81	CR-9/Lake Dr/42nd Ave	11800248	Northbound	45.03184	-93.3378	45.03227	-93.3383	0.03803
118P05561	P1.11	CR-81	MN-100	11800248	Northbound	45.03539	-93.342	45.03708	-93.3434	0.136584
118P05563	P1.11	CR-81	CR-10/56th Ave/Bass Lake Rd	11800248	Northbound	45.05365	-93.3572	45.05468	-93.3582	0.085877
118P05564	P1.11	CR-81	63rd Ave	11800248	Northbound	45.06923	-93.3678	45.06933	-93.3679	0.007395
118P05565	P1.3	CR-81	I-94/I-694/US-52	11800248	Northbound	45.07563	-93.3719	45.08118	-93.3756	0.423111
118P05566	P1.11	CR-81	CR-8/71st Ave	11800248	Northbound	45.08367	-93.3771	45.08379	-93.3772	0.009321
118P05567	P1.11	CR-81	MN-152/CR-130/Brooklyn Blvd	11800248	Northbound	45.09448	-93.3841	45.09512	-93.3845	0.049588
118P05568	P1.11	CR-81	US-169	11800248	Northbound	45.10554	-93.3921	45.10658	-93.3928	0.078856
118P05619	P1.11	MN-100	Duluth St	11800087	Northbound	44.99545	-93.3493	45.00361	-93.3492	0.563423
118P05620	P1.11	MN-100	36th Ave	11800087	Northbound	45.01683	-93.3493	45.02542	-93.3474	0.601453
118P05621	P1.11	MN-100	CR-9/42nd Ave	11800087	Northbound	45.02818	-93.3473	45.03132	-93.347	0.217428
118P05622	P1.11	MN-100	CR-81	11800087	Northbound	45.03654	-93.3426	45.03871	-93.3394	0.219541
118P05623	P1.11	MN-100	France Ave	11800087	Northbound	45.04028	-93.3347	45.04625	-93.3263	0.596793

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**Data Sample**

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**INRIX TH 100**  
**Sample Data**  
**NB TH 100 - 77th Street to Cedar Lake Road**

Timestamp	Free Flow		Abnormality	Avg Speed	Distance (miles)
	Travel Time (min)	Reported Travel Time (min)			
2012-02-01T17:20:53	8	8	-1	56	7.4
2012-02-01T17:21:02	8	8	-1	56	7.4
2012-02-01T17:23:01	8	8	-1	56	7.4
2012-02-01T18:00:05	8	8	-1	56	7.4
2012-02-01T18:03:01	8	9	0	53	7.4
2012-02-01T18:06:00	8	9	0	54	7.4
2012-02-01T18:09:00	8	9	0	55	7.4
2012-02-01T18:12:00	8	8	-1	56	7.4
2012-02-01T18:15:00	8	8	-1	56	7.4
2012-02-01T18:18:03	8	8	-1	56	7.4
2012-02-01T18:21:00	8	9	0	55	7.4
2012-02-01T18:24:00	8	9	0	54	7.4
2012-02-01T18:27:00	8	9	0	54	7.4
2012-02-01T18:30:00	8	9	0	54	7.4
2012-02-01T18:33:00	8	9	0	55	7.4
2012-02-01T18:36:00	8	9	0	55	7.4
2012-02-01T18:39:00	8	9	0	55	7.4
2012-02-01T18:42:02	8	9	0	56	7.4
2012-02-01T18:45:00	8	8	-1	56	7.4
2012-02-01T18:48:00	8	8	-1	56	7.4
2012-02-01T18:51:00	8	8	-1	56	7.4
2012-02-01T18:54:00	8	9	0	55	7.4
2012-02-01T18:57:00	8	9	0	55	7.4
2012-02-01T19:00:00	8	9	0	55	7.4
2012-02-01T19:03:00	8	9	0	55	7.4
2012-02-01T19:06:00	8	8	-1	56	7.4
2012-02-01T19:09:02	8	9	0	55	7.4
2012-02-01T19:12:02	8	8	-1	56	7.4
2012-02-01T19:15:02	8	8	-1	56	7.4
2012-02-01T19:18:00	8	8	-1	56	7.4
2012-02-01T19:21:00	8	8	-1	56	7.4
2012-02-01T19:24:04	8	8	-1	56	7.4
2012-02-01T19:27:00	8	8	-1	56	7.4
2012-02-01T19:30:00	8	9	0	55	7.4
2012-02-01T19:33:00	8	9	0	55	7.4
2012-02-01T19:36:00	8	9	0	55	7.4
2012-02-01T19:39:00	8	9	0	55	7.4
2012-02-01T19:42:02	8	9	0	55	7.4
2012-02-01T19:45:00	8	9	0	55	7.4
2012-02-01T19:48:00	8	8	-1	56	7.4

Timestamp	Free Flow Travel Time (min)	Reported Travel Time (min)	Abnormality	Avg Speed	Distance (miles)
2012-02-01T19:51:00	8	8	-1	56	7.4
2012-02-01T19:54:00	8	8	-1	56	7.4
2012-02-01T19:57:00	8	8	-1	56	7.4
2012-02-01T20:00:00	8	8	0	56	7.4
2012-02-01T20:03:00	8	8	0	56	7.4

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## TH 100 Data Comparison

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## 7.0 I-35 Construction

As the final scope for this project was being developed, MnDOT expressed a desire to use data provided by INRIX as the basis for providing delay information to motorists traveling on I-35 between the Minneapolis – St. Paul metro area and Duluth. Several construction zones were planned for this rural corridor for the summer of 2011. Within the construction area the four-lane freeway would operate as two lanes, one in each direction. Due to this urgency, the planned project path of developing the project concept of operations and functional requirements was delayed and coordination begun for providing the data for the construction project.

Following is a summary of results of using the data in this manner:

- INRIX provides travel time data and the project schedule and budget did not allow for them to modify their process to provide travel delay data. Therefore the construction contractor converted the data and provided it for display on variable message boards.
- The corridor has very directional and heavy weekend traffic flows due to the tourist/vacation trips to northern Minnesota. As a result, the data provided by INRIX appeared to be accurate and met observed conditions during the week and on Friday. However, this data was not accurate on Sundays. The apparent causes of the poor Sunday data are:
  - Lack of commercial vehicle traffic (probe data) during that time period.
  - While INRIX’s use of smartphone apps as probes is increasing, it was not large enough at the time of this project on this corridor.
  - INRIX offered at its expense, to recruit corridor travelers with smartphones or modifying their use of historical data during the weekend, to only include historical weekend data and a marketing campaign to drive the use of apps in the project area. The project timing and urgency did not allow for these steps to be taken.
- Due to the limitations of the data on Sundays, the use of the data was terminated after several months.



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## 8.0 TH 100 Evaluation

A primary goal of the TH 100 evaluation was to conduct a comparison of the travel time data provided by the commercial probe data contractor (the INRIX system) with travel times available from the MnDOT Regional Transportation Management Center (RTMC). It was determined that the most appropriate MnDOT data available for this comparison are the estimated travel times reported on each dynamic message sign (DMS) located along the TH 100 corridor.

**Figure 1 – TH 100 Corridor**



Figure 1 shows the locations of the four dynamic message signs from which data were extracted for this evaluation. The three northbound signs are identified as: V100N01, located just north of I-494; V100N05, located just south of Minnetonka Boulevard; and V100N08, located just south of the Duluth Street exit ramp. The lone southbound sign is identified by MnDOT as V100S04 and is located just north of the TH 55 exit.

Also shown in Figure 1 are the locations of the travel time segment end points, which correspond to the destinations reported on MnDOT DMS signs along TH 100. In the northbound direction, from south to north the reported destinations are I-394, TH 55, CR 81, and I-694. In the southbound direction, from north to south the reported destinations are TH 7 and I-494.

Precise locations of both the signs and the travel time segment end points were provided to INRIX in latitude/longitude format, allowing the same segments to be used in estimating travel times in the INRIX system as are used by MnDOT for their DMS signs. Latitude and longitude information is presented in Table 1 below. Be aware that the reported destinations on the signs do not correspond exactly to the endpoints' latitude and longitude coordinates, but in all cases the end point is relatively close to the reported destination on the DMS sign. For example, the I-694 endpoint for northbound travel times (45.05858 N, 93.30902 W), is actually located at the 57th Avenue bridge crossing TH 100, approximately one mile south of I-694. Each of the other endpoints is within 1/2 mile of its reported destination. Table 1 also shows the segment lengths for each sign/reported destination pair, as well as a Route ID employed in the data received from INRIX.

**Table 1 – Sign and Travel Time Destination Details**

Direction	MnDOT Sign ID	Approximate Location	Latitude, Longitude (degrees)	Reported Destination	Latitude, Longitude (degrees)
Northbound	V100N01	77th Street	44.86399N, 93.34971W	I-394	44.96683N, 93.34260W
				I-694	45.05858N, 93.30902W
	V100N05	Minnetonka Boulevard	44.95312N, 93.34768W	TH 55	44.98689N, 93.34933W
				I-694	shown above
	V100N08	Duluth Street	44.99244N, 93.34938W	CR 81	45.03261N, 93.34630W
				I-694	shown above
Southbound	V100S04	TH 55	44.99091N, 93.34945W	TH 7	44.94700N, 93.34806W
				I-494	44.86518N, 93.35034W

MnDOT DMS reported travel time data was collected from February 1 through May 31, 2012. These signs generally are active only during the weekday afternoon (PM) peak periods, from 2:00 to 7:00 PM. A sample of data received from MnDOT is presented in Table 2. That table contains a full day’s worth of records for one DMS sign (V100N01 in this case). For each record, the data shown includes the MnDOT sign ID, the date and time of the change in the sign message, a description of what the sign has been commanded to do, and the message displayed on each of the three DMS lines at that time. Note that a new MnDOT data record is generated only when a change is made on the sign. Consequently, the data in Table 2 shows that on March 14, 2012, the initial sign message was displayed at 2:00 PM and over the next 5 hours the sign message changed 48 times, with the sign being cleared (i.e., no message displayed) at 7:00 PM. Also worth noting is that the sign message may change more than once within the same one-minute time period. As an example, during the 4:40 PM interval the travel time to I-694 first changed from 17 minutes to 16 minutes, then changed once again to 17 minutes.

**Table 2 – Sample Data from MnDOT DMS Log**

device_id	event_date	description	line1	line2	line3
V100N01	3/14/12 2:00 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]8 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 4:11 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 4:14 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:15 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 4:16 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:20 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:20 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:31 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 4:33 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:35 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 4:38 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:40 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 4:40 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:42 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 4:48 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:50 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:56 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 4:56 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 5:05 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 5:07 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 5:08 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 5:12 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 5:16 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]18 MIN
V100N01	3/14/12 5:19 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]19 MIN
V100N01	3/14/12 5:20 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]19 MIN
V100N01	3/14/12 5:20 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]20 MIN
V100N01	3/14/12 5:23 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]21 MIN
V100N01	3/14/12 5:24 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]12 MIN	[j12]694 [j14]21 MIN
V100N01	3/14/12 5:25 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]12 MIN	[j12]694 [j14]22 MIN
V100N01	3/14/12 5:25 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]12 MIN	[j12]694 [j14]21 MIN
V100N01	3/14/12 5:26 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]21 MIN
V100N01	3/14/12 5:28 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]12 MIN	[j12]694 [j14]21 MIN
V100N01	3/14/12 5:29 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]21 MIN
V100N01	3/14/12 5:30 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]12 MIN	[j12]694 [j14]21 MIN
V100N01	3/14/12 5:31 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]20 MIN
V100N01	3/14/12 5:33 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]19 MIN
V100N01	3/14/12 5:33 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]19 MIN
V100N01	3/14/12 5:36 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]20 MIN
V100N01	3/14/12 5:37 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]12 MIN	[j12]694 [j14]20 MIN
V100N01	3/14/12 5:37 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]11 MIN	[j12]694 [j14]19 MIN
V100N01	3/14/12 5:39 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]18 MIN
V100N01	3/14/12 5:41 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]19 MIN
V100N01	3/14/12 5:42 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]10 MIN	[j12]694 [j14]18 MIN
V100N01	3/14/12 5:42 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]18 MIN
V100N01	3/14/12 5:43 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 5:47 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 5:51 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]17 MIN
V100N01	3/14/12 5:53 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]9 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 5:56 PM	Sign DEPLOYED	FREEWAY TIME TO	[j12]394 [j14]8 MIN	[j12]694 [j14]16 MIN
V100N01	3/14/12 7:01 PM	Sign CLEARED			

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Simultaneously with the MnDOT data collection from its DMS logs, data was being collected by the INRIX system for each of its “routes”. As shown above in Table 1, an INRIX “route” corresponds to a combination of a sign and a reported destination. From February 1 at 8:00 AM to March 3 at 1:00 PM INRIX data was recorded once every 3 minutes; thereafter INRIX data was recorded once every minute until 7:25 AM on June 1, 2012. In addition, unlike the MnDOT DMS data, which was recorded only while the signs were active – generally from 2:00 to 7:00 PM on weekdays – INRIX data was recorded 24 hours a day, 7 days a week. This means that for each sign/endpoint combination 1440 records of one-minute data were generated for each day.

Shown in Table 3 is a sample of the data received from INRIX. The data is for route 10900126, pertaining to the segment from MnDOT sign V100N01 to the endpoint corresponding to I-694. The data shown is for March 14, 2012, from 5:15 through 5:44 PM, which is a subinterval of the time period shown in Table 2 for the MnDOT data. The first column in the INRIX data is a timestamp for the data record. Initially, a problem with the data analysis developed when it was not realized that the timestamp corresponds to the time of day in the Pacific Time Zone rather than the Central Time Zone. Once discovered, this problem was easily remedied by adding two hours to each of the time stamps to arrive at a time corresponding to the MnDOT data set. Other data included in the INRIX data are: “free flow travel time”, which corresponds to the expected travel time through the segment with uninterrupted traffic flow; the “reported travel time”, which is the estimate of actual travel time from INRIX based on its probe vehicle data; the average speed, in miles per hour; and distance, which corresponds to the length of the travel time data segment.

**Table 3 – Sample INRIX Data, Route 10900126**

Timestamp	Free Flow Travel Time (min)	Reported Travel Time (min)	Abnormality	Avg Speed (mph)	Distance (miles)
2012-03-14T15:15:00	15	17	-5	54	14.5
2012-03-14T15:16:00	15	17	-5	54	14.5
2012-03-14T15:17:00	15	17	-5	54	14.5
2012-03-14T15:18:00	15	18	-4	50	14.5
2012-03-14T15:19:01	15	18	-4	51	14.5
2012-03-14T15:20:28	15	17	-5	51	14.5
2012-03-14T15:21:16	15	18	-4	51	14.5
2012-03-14T15:22:27	15	18	-4	51	14.5
2012-03-14T15:23:30	15	18	-4	51	14.5
2012-03-14T15:24:31	15	18	-4	51	14.5
2012-03-14T15:25:37	15	19	-3	48	14.5
2012-03-14T15:26:02	15	19	-3	48	14.5
2012-03-14T15:27:03	15	19	-3	48	14.5
2012-03-14T15:28:02	15	19	-3	46	14.5
2012-03-14T15:29:00	15	19	-3	48	14.5
2012-03-14T15:30:01	15	19	-3	46	14.5
2012-03-14T15:31:00	15	20	-2	44	14.5
2012-03-14T15:32:01	15	21	-1	42	14.5
2012-03-14T15:33:01	15	21	-1	42	14.5
2012-03-14T15:34:00	15	22	0	40	14.5
2012-03-14T15:35:00	15	22	0	40	14.5
2012-03-14T15:36:00	15	22	0	40	14.5
2012-03-14T15:37:00	15	22	0	40	14.5
2012-03-14T15:38:00	15	21	-1	43	14.5
2012-03-14T15:39:00	15	21	-1	43	14.5
2012-03-14T15:40:00	15	20	-2	45	14.5
2012-03-14T15:41:00	15	21	-1	43	14.5
2012-03-14T15:42:00	15	21	-1	43	14.5
2012-03-14T15:43:01	15	20	-2	44	14.5
2012-03-14T15:44:01	15	21	-1	43	14.5

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## Comparison of Results

As indicated earlier, MnDOT estimated travel time data from four DMS signs, each with two destinations, and INRIX estimated travel time data from eight INRIX routes, corresponding to the DMS sign/destination combinations, was collected from February 1 through May 31, 2012.

Based on the project's functional requirements documents, one goal of the project was to confirm the accuracy and reliability of data collected using a MnDOT roadway which is instrumented (TH 100), comparing existing traffic data collected and disseminated by MnDOT's RTMC with data collected via INRIX.

Two sets of performance goals were established in the functional requirements jointly between MnDOT and the evaluation consultant. Extensive discussion occurred relative to what the appropriate measures should be, in particular whether time differences should be evaluated based on actual time differences between MnDOT data and INRIX data or on the percentage of the time differences. It was determined that the time difference in minutes should be the primary measure of effectiveness.

Percentage difference was excluded as the most appropriate measure of effectiveness due to the way in which the travel times are reported and due to the short lengths of some of the segments. First, travel times reported by INRIX and by MnDOT were both provided in a whole number of minutes. Therefore, the precision of the differences was relatively poor. As an example, MnDOT may have reported a segment travel time of 4 minutes, and INRIX may have reported a segment travel time of 5 minutes for the same segment at the same time. Therefore, the reported difference between the two methods is 1 minute. However, because each of these values represents a value rounded to the nearest minute, the actual travel time for the MnDOT data could have been anywhere from just over 3.5 minutes to just under 4.5 minutes, and the INRIX travel time could have been anywhere from just over 4.5 minutes to just under 5.5 minutes. Therefore, the actual travel time difference between the two methods could have been anywhere from near zero (both methods just under or just over 4.5 minutes) up to near 2 minutes (3.5 from the MnDOT method compared to 5.5 from the INRIX method).

The second reason percentage difference was excluded is the short segment length of several of the segments. For example, the distance from DMS V100S04 to TH 7 is 3.2 miles. Under free flow conditions at 60 mph, the travel time would be expected to be approximately 3.2 minutes. Slightly slower traffic could easily be estimated by MnDOT as 3.4 minutes, rounded to 3 minutes, and estimated by INRIX as 3.6 minutes, rounded to 4 minutes, or vice versa. Consequently, an actual difference of 0.2 minutes, representing just 5.9 percent of the 3.4 minutes estimated by MnDOT, becomes a difference of 1 minute using the reported values, representing 33.3 percent of the 3 minutes reported by MnDOT.

The first set of performance goals was segment-based. Consequently, for any given segment (or "route" in INRIX terminology), it was desired that:

- 98.5% of INRIX data results should be less than 4 minutes different from MnDOT dynamic message sign (DMS) data
- 98.0% of INRIX data results should be less than 3 minutes different from MnDOT DMS data
- 95.0% of INRIX data results should be less than 2 minutes different from MnDOT DMS data

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The second set of performance goals was corridor-based. Specifically, combining data for all segments, it was desired that:

- 99.0% of INRIX data results should be less than 4 minutes different from MnDOT DMS data
- 98.0% of INRIX data results should be less than 3 minutes different from MnDOT DMS data
- 96.5% of INRIX data results should be less than 2 minutes different from MnDOT DMS data

Table 4 shows the results of the comparative analysis for each segment and for the corridor as a whole. Shown for each segment are the length of the segment (distance), the number of comparisons performed, the absolute difference between the INRIX data and the MnDOT data, and the percentages of the total sample which fell within 1 minute, 2 minutes, 3 minutes, 4 minutes, and 5 minutes. As described above, the critical times are the 2-, 3- and 4-minute differences. Checkmarks have been placed adjacent to all measures which meet the criteria specified above. As can be seen, the first segment shown – the 7.4-mile segment from sign V100N01 to I-394 – met only the 4-minute criteria, and the second segment – the 14.5-mile segment from sign V100N01 to I-694 – met none of the criteria. On the other hand all other segments met each of the three criteria, as did the corridor as a whole.

**Table 4 – Travel Time Comparison Results**

**Sign V100N01, at 77th Street**

	Difference			Difference	
	(minutes)	% within		(minutes)	% within
<b>to I-394</b>			<b>to I-694</b>		
Distance	1	82.8%	Distance	1	80.0%
7.4 miles	2	92.7%	14.5 miles	2	91.9%
Sample	3	96.7%	Sample	3	95.8%
Size	4	98.8% ✓	Size	4	97.6%
19688	5	99.6%	19683	5	98.6%
Absolute difference (min)		1.2	Absolute difference (min)		1.2

**Sign V100N05, at Minnetonka Boulevard**

	Difference			Difference	
	(minutes)	% within		(minutes)	% within
<b>to TH55</b>			<b>to I-694</b>		
Distance	1	96.8%	Distance	1	91.5%
2.5 miles	2	99.2% ✓	8.3 miles	2	96.7% ✓
Sample	3	99.8% ✓	Sample	3	98.5% ✓
Size	4	99.9% ✓	Size	4	99.3% ✓
19419	5	100.0%	19415	5	99.6%
Absolute difference (min)		0.2	Absolute difference (min)		0.8

**Sign V100N08, at Duluth Street**

	Difference			Difference	
	(minutes)	% within		(minutes)	% within
<b>to CR 81</b>			<b>to I-694</b>		
Distance	1	98.1%	Distance	1	95.0%
2.8 miles	2	99.5% ✓	5.4 miles	2	98.8% ✓
Sample	3	99.8% ✓	Sample	3	99.6% ✓
Size	4	99.9% ✓	Size	4	99.8% ✓
19737	5	100.0%	19734	5	99.9%
Absolute difference (min)		0.2	Absolute difference (min)		0.4

**Sign V100S04, at TH 55**

	Difference			Difference	
	(minutes)	% within		(minutes)	% within
<b>to TH 7</b>			<b>to I-494</b>		
Distance	1	98.4%	Distance	1	94.6%
3.2 miles	2	99.6% ✓	8.9 miles	2	99.4% ✓
Sample	3	99.8% ✓	Sample	3	99.7% ✓
Size	4	99.9% ✓	Size	4	99.9% ✓
19726	5	99.9%	19726	5	99.9%
Absolute difference (min)		0.3	Absolute difference (min)		0.9

**Entire Corridor, all segments**

	Difference	
	(minutes)	% within
	1	92.1%
	2	97.2% ✓
Sample	3	98.7% ✓
Size	4	99.4% ✓
157128	5	99.7%
Absolute difference (min)		0.7



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## 9.0 Cost Comparison

The cost of using INRIX data to provide arterial travel time information was compared to the use of Bluetooth Technology, another non-infrastructure based system. The comparison is for a 7 mile arterial corridor. Cost information for the Bluetooth Technology was taken from the “ITS Innovative Idea Project, Arterial Travel Time Monitoring System Using Bluetooth Technology, Final Report” prepared for MnDOT by Iteris and dated March 2011.

### Bluetooth Technology

- Hardware/Software/Installation = \$48,000
- Monthly Operational Cost = \$340

### INRIX

- Set-up Cost (\$200/mile) = \$1,400
- Monthly Data Cost (\$62.50/mile) = \$440

With the INRIX system costing \$46,600 less to initialize and having a \$100 higher monthly cost, the INRIX system would remain cost effective over the Bluetooth Technology for over 38 years.



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## **10.0 Conclusions**

This project has shown that INRIX can provide travel time data for arterial routes that is comparable to data currently collected by MnDOT. The data can also be provided in a cost effective manner.

INRIX travel time data can also be used for other scenarios, such as construction zones. In these situations, to assure accurate data, the route needs to be analyzed to understand the routes traffic flow characteristics so that the data gathered will compliment those characteristics.